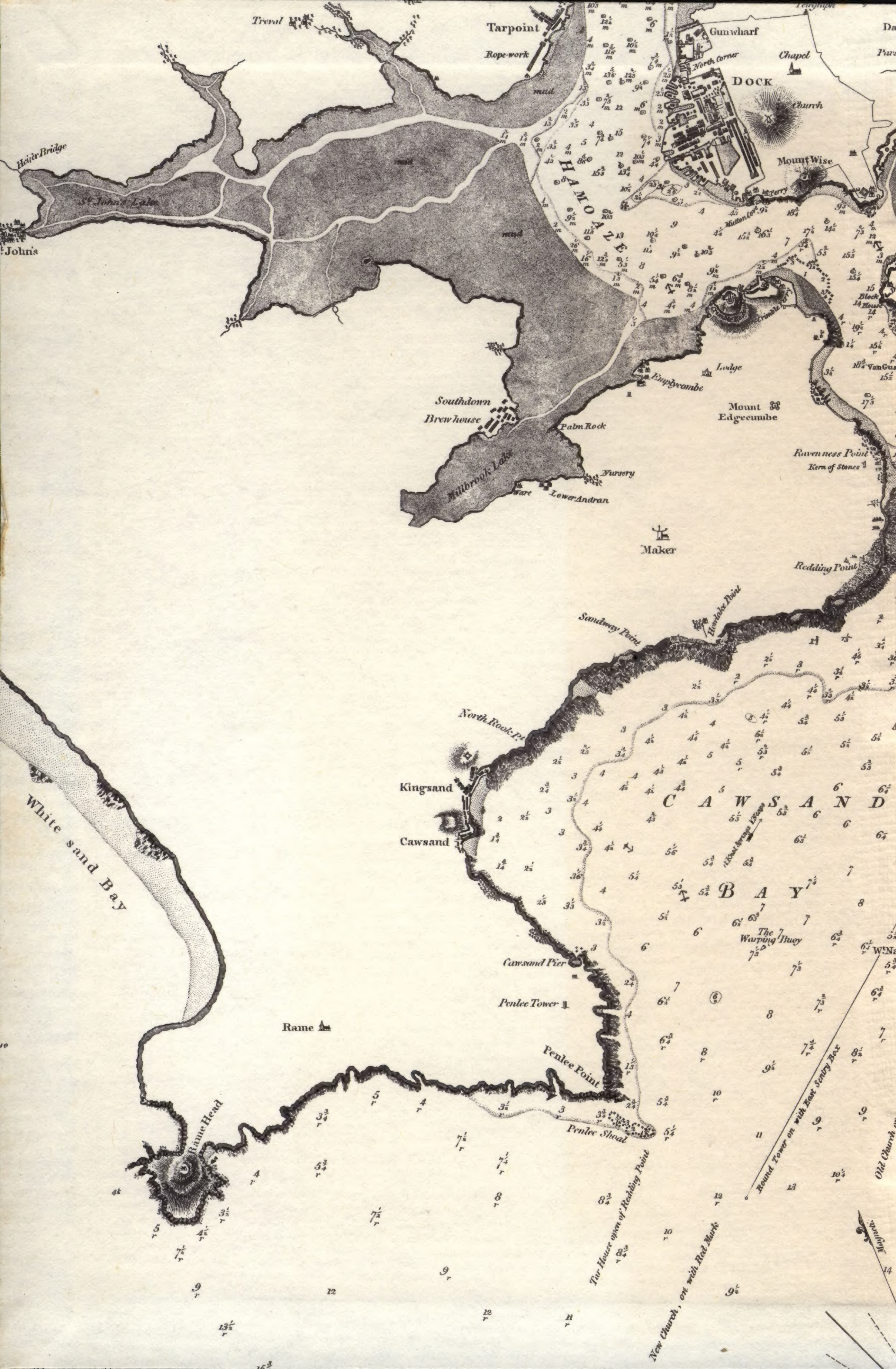
A. DAY

The Admiralty Hydrographic Service 1795–1919

HMSO

The Admiralty Hydrographic Service 1795-1919

VICE-ADMIRAL SIR ARCHIBALD DAY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St. Johns Lake
St. John's
Block House
Lodge
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Mount Edgecumbe
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Palm Rock
Millbrook Lake
Ware
Lower Andran
Nursery
Ravenness Point
Kern of Stones
Maker
Redding Point
Sandway Point
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North Rook Pt.
Kingsand
Cawsand
CAWSAND BAY
White sand Bay
The Warping Buoy
Cawsand Pier
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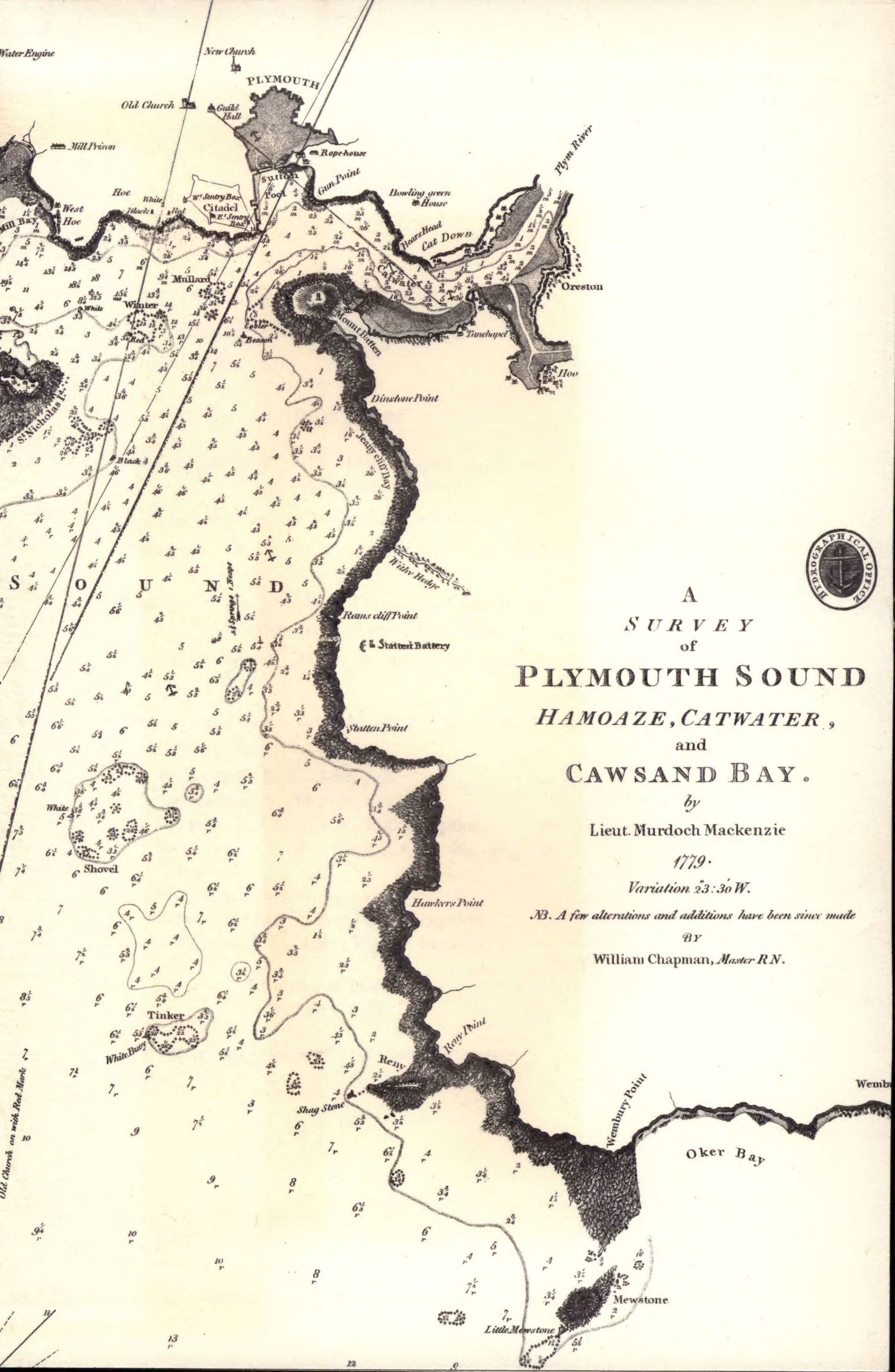
Rame
Penlee Point
Penlee Shoal
Rame Head
Tar House open of Redding Point
New Church, on with Red Mark
Round Tower on with East Sentry Box



HYDROGRAPHICAL OFFICE

A
SURVEY
of
PLYMOUTH SOUND
HAMOAZE, CATWATER,
and
CAWSAND BAY.

by

Lieut. Murdoch Mackenzie

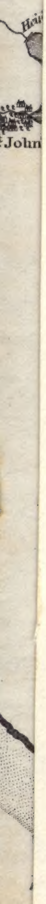
1779.

Variation 23°: 30′ W.

NB. A few alterations and additions have been since made

BY

William Chapman, *Master RN.*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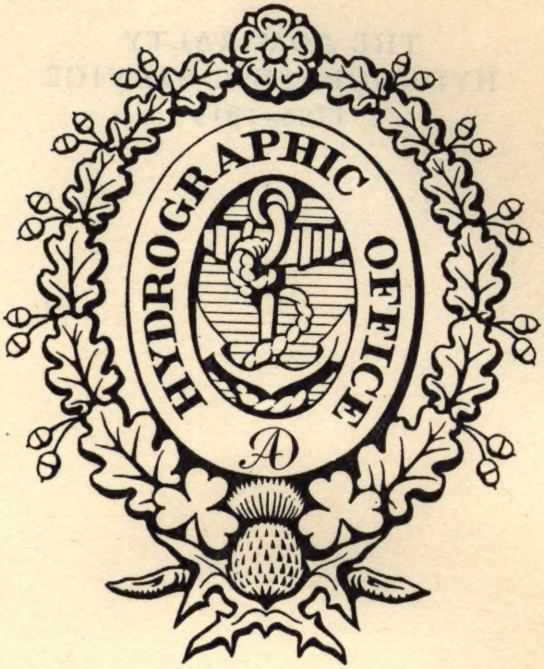
THE ADMIRALTY
HYDROGRAPHIC SERVICE
1795–1919



The seal of the Hydrographic Department. Below the anchor appear the Hydrographer's initials, in this case A. D.—those of the author, who served as Hydrographer of the Navy from 1950 to 1955.

MINISTRY OF DEFENCE

The Admiralty Hydrographic Service

1795-1919

VICE-ADMIRAL SIR ARCHIBALD DAY
K.B.E. C.B. D.S.O.
Formerly Hydrographer of the Navy

LONDON
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1967

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FOREWORD

by Rear-Admiral Sir Edmund G. Irving, K.B.E., C.B.

Hydrographer of the Navy from 1960 to 1966

SOME TWENTY-FIVE years ago, a continuation of Commander L. S. Dawson's *Memoirs of Hydrography*, 1750–1885, was drafted by Rear-Admiral A. L. Jackson to bring them up to 1932. Further research was necessary to expand it into a more comprehensive document, and Mr G. B. Stigant, O.B.E., and Mr L. A. Luff, M.B.E., late of the Hydrographic Department, carried out a close study and indexing of the historical records held by the department.

Vice-Admiral Sir Archibald Day has used their work, and combed the Admiralty papers at the Public Record Office of prior date to it, to produce an introduction to the mass of material that is available in the Hydrographic Department's incomparable collection of survey documents and old copies of books, charts, letters, and reports that go back to Captain Cook's times.

He has not laboured in vain, for his efforts to bring to light the absorbing history of the oldest department of the Navy Office will not only serve to give a lead to students of British naval history, but will also encourage others to reflect on the immense contribution that the naval surveyors have made to Britain's maritime greatness through their untiring zeal in opening the way for trade with the world.

PREFACE

THIS CONTINUATION of Dawson's *Memoirs of Hydrography*, Parts I and II,* completed in 1885, commences with a chapter recapitulating the work of the Hydrographic Department from 1795 to 1884, which Dawson did not cover with the same exhaustive detail as he gave to the section headed ' Progress of Marine Surveys '.

Dawson's plan is then continued. Each Hydrographer is allocated a chapter, which commences with his biography and continues with an account of departmental activities and the progress of the surveys during that period. Short biographies are then given for senior officers afloat and civilians ashore whose active employment was concluded during his tenure of office. These biographies have mainly been taken from a draft prepared by Rear-Admiral Jackson in the early 1940's.

The research involved in the preparation of this book has been facilitated in great measure by the prior sorting and classification of departmental records by Messrs G. B. Stigant, O.B.E., and L. A. Luff, M.B.E. The latter's selection of items of historical interest from the voluminous minute-books and his arrangement of these items into chronological and other indexes have proved invaluable.

A. D.

Wye, 1966

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* Published in 1885 at Eastbourne (Henry W. Keay, the ' Imperial Library '), they have long been out of print. Copies are held by the Naval Library, the Royal Geographical Society, and (Part II only) the National Maritime Museum.

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Rear end-paper—Plymouth Sound and Hamoaze, 1916 edition

I

The Period of Dalrymple to Evans

1795–1884

HYDROGRAPHERS

Dalrymple 1795; Hurd 1808;
Parry 1823; Beaufort 1829; Washington 1855;
Richards 1864; Evans 1874[1]

THIS CHAPTER reviews the means and measures by which Hydrographers met the responsibilities set them by the Order in Council of 12 August 1795,[2] and by subsequent instructions, until the year 1884. The intention is to show how the foundation and framework of the Hydrographic Department took shape in order to make use of the documents, mentioned in the Order, for the benefit of the Navy and the mercantile marine; and how the Navy's surveying service was formed to improve and enlarge the invaluable store of original information.

At the time of the Order in Council, the country had been at war with the French Republic for two years, and the danger had been intensified when the British and Allied armies had been driven from Flanders and Holland. Overseas, since the end of the American War of Independence in 1783, there had been a decade of rising prestige and prosperity in the British Empire. There had been expansion in Canada and Newfoundland, taken from the French twenty years earlier, and in the territory of the Hudson Bay Company, whose charter was granted by Charles II in 1670. The Pacific coast had been the scene of another naval expedition of exploration and survey under Vancouver in the *Discovery*,[3] dispatched by the Admiralty in 1791. Following in the wake of Cook, with whom Vancouver had served, the expedition crossed the Pacific to re-establish the British position from the claims of the

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[1] Other surveying officers mentioned in Dawson's *Memoirs of Hydrography* are similarly referred to by their surnames only.

[2] Appendix A, 1.

[3] The prefix H.M.S. is omitted when referring to surveying ships.

Spanish in Nootka Sound, and then surveyed the vicinity of Vancouver Island and the coast to the north-westward, bearing in mind a possible exit to the North-west Passage. Broughton, who had been sent home by Vancouver with dispatches, had, despite the war, sailed again in the *Providence* in 1793, and for four years he explored and surveyed in the western North Pacific. This work included the south-eastern coasts of Japan—a country that was to resist contact with Western civilization until the mid-nineteenth century and the visit of an American, Commodore Perry; an Englishman, Adams, had, however, been at the Imperial Court following his shipwreck in a Dutch East Indiaman in 1600.

In India, as in Canada, French influence had come to an end in 1763. The East India Company, whose original charter was granted by Elizabeth I in 1600, had continued to extend its trading through Penang and the archipelago to Canton, although in 1784 the Crown had begun to take over some responsibility from it. In Australasian waters, Flinders had arrived in 1795 with Captain John Hunter, Governor designate of New South Wales, and started to follow up the exploratory surveys of the voyages made by Cook twenty years earlier, during which time the British flag had been raised in Australia and New Zealand. The route to the East lay round the Cape of Good Hope, which from 1795 was in British hands, though its repossession by the Dutch in accordance with the Treaty of Amiens in 1802 was to last for four years. Beyond Gibraltar, British since its capture in 1704, the island ports of call were Portuguese Madeira, St Helena, held by the East India Company since 1659, and Mauritius, until 1810 a French possession known as Ile de France. On the African coast, Sierra Leone had been ceded to Great Britain in 1787 to serve as an asylum for freed slaves. Dutch and Portuguese fortified posts were sited there, and strong prospects existed of continued rivalry with the French and Spanish, both there and on many other partly explored seas and coasts. The long campaign (1793–96) against the French in the West Indies was in progress.

In this setting, with the awareness of hydrographic progress in other maritime countries,[1] and in a period of wartime expansion in the Navy Vote, the then Commissioners for executing the Office of Lord High Admiral of the United Kingdom, headed by Earl Spencer, and including Admiral Sir Charles Middleton (later Lord Barham), again took up the establishment of a hydrographic office. It had earlier been advanced without result by such spokesmen as Lord Anson, and notably by Lord Howe in 1769,[2] whose persistence was, however, successful in that, by Government command, the surveys of the eastern seaboard of North America were compiled for the Admiralty by des Barres, between 1777 and 1784, and issued as a set of charts—*The Atlantic*

---

[1] The French Hydrographic Office was established in 1720; the Danish in 1784. The Spanish followed in 1800. The Honourable East India Company had been active for more than a century.

[2] Mentioned in *Surveys of the Seas*, see Bibliography 3, 5.

Neptune—to the British naval forces in the American War of Independence.[1] So, the 1795 Order in Council was drafted, the opening paragraph reading:

> The great inconvenience which has constantly been felt by the Officers in Your Majesty's Fleet, especially when ordered abroad, from the want of sufficient information respecting the navigation of those parts of the world to which their services may be directed, and with which they are sometimes totally unacquainted, has led us to consider of the means most advisable to be adopted for furnishing such information, and for preventing, as much as possible, the difficulties and dangers to which Your Majesty's Fleet must consequently be exposed from any defect on this head.

It concluded, '... the actual expense of this new establishment will not exceed four hundred and seventy pounds per annum '.

Thus, from the outset it was acknowledged that the Royal Navy needed charts of every sea. And, after the victory at Trafalgar ten years later had made the high seas safer for commerce, Britain's expanding interests overseas meant that her mercantile marine also stood in urgent need of accurate charts and navigational information on a world-wide basis. Owing to the magnitude of this task one constant concern of successive Hydrographers was, and has continued to be, to seek a commensurate share of the Navy Vote in terms of money, manpower, and ships. They had to make the best use of the resources allocated to them when governmental retrenchment reduced the over-all expenditure on the armed forces. They had to accept disappointments when a return to peace seemed the occasion to make progress in hydrography but all too soon became the opportunity for such retrenchment; or when either civil or naval members of the Board of Admiralty lacked appreciation of the department's work. For example, Croker,[2] Secretary of the Admiralty, looked with disfavour on the institution of the department on the grounds that as it had not existed before it could not be indispensable; and Beaufort in his day referred to ' the natural tendency of men to undervalue what they do not understand '. Nevertheless, the Admiralty had, in the words of Sir Oswyn Murray,[3] put its hand to ' the continuous charting of the seas '.

1795–1808

Dalrymple was appointed Hydrographer as soon as the Order in Council was approved, and, at the age of fifty-eight, he brought extensive experience of hydrography from his service with the East India Company. Information in the Admiralty records[1] shows that, besides the clerical assistance provided by the Order, John Walker was employed copying and reducing plans from October 1795, and from 1797 was engaged on the basis of a quarterly salary. For a short time Arrowsmith was an ‘ indifferent assistant ’, and a later comment by Dalrymple runs, ‘ . . . in 1800 when the Hydrographical Office was made efficient and I was desired to look for engravers . . . Mr John Walker was appointed to superintend them under my direction ’. The engravers were Cooke and Palmer, who were succeeded by Bailey in 1807, at which date there were also two draughtsmen, Andrews and Higgins, the latter having been provided in 1800 to assist Hurd with the drawing of his charts of the Bermudas in the office.

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[1] Bibliography 2, 6.

[2] J. W. Croker (1780–1857) was Secretary of the Admiralty from 1809 for twenty-two years. In the *Dictionary of National Biography*, it is said that his heart was in his work coupled with a determination to obtain full value for money spent; that his manner was often overbearing and harsh though there were no complaints of his official conduct; and that when on one occasion he referred to himself as ' only a servant of the Board ', a contemporary Lord Commissioner remarked that it was really the other way round.

[3] Bibliography 3, 13.

So, in 1800, some years of sorting and classifying existing documents could at last be turned to account in making a start with the preparation of new copper plates and with the addition of new information to those few that were already available. So, too, the association was established between, on the one hand, the seagoing surveying officers having practical experience of navigation and, on the other hand, the civilian element that developed the cartographic art of converting surveys into charts. Meanwhile, the Secretary of the Admiralty retained responsibility for purchasing the requisite charts from the various publishers and for issuing these charts to the Fleet, which at that time was containing the French and Spanish navies in both the Atlantic and the Mediterranean, e.g. the Battle of the Nile in Abu Qir Bay (1798), while also preventing Napoleon’s use of the Dutch and Danish fleets—accomplished earlier by operating off Texel until Camperdown (1797) and later by entering the Kattegat to fight the Battle of Copenhagen (1801).

After the uneasy and year-long Peace of Amiens, war with France broke out again, partly on the issue of the British refusal to give up Malta to a neutral in accordance with the treaty. It continued throughout Dalrymple’s term of office, the Fleet being mainly engaged in frustrating Napoleon’s plans for invasion until the culmination at Trafalgar in 1805, but otherwise convoying Indiamen and transports to distant destinations. In 1806–7 an expedition sailed from South Africa to capture Buenos Aires; and Beaufort being present surveyed the river Plate. This intervention to foster the South American movement for independence from the Spanish and their French masters was followed ten years later by Admiral Lord Cochrane’s part in successfully commanding a rebel Chilean fleet. This resulted in benefit to our trading activity with the South American continent, which our merchantmen were ready to take up, and a need for surveys of its coasts, on which task our surveying ships were later welcomed despite the Monroe doctrine laid down in 1823 to counter European designs on South America and also those of Russia on the then unoccupied Pacific coast to the northward.

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[1] Appendix B, 1.

In March 1800 Dalrymple wrote:

> I will as soon as possible give a list of the charts and plans in the Hydrographical Office that are in my opinion fit to be engraved, distinguishing such that are on too large a scale, and therefore requiring to be reduced. . . . I am decidedly of opinion that it would be very expedient to fix up a rolling-press in the Admiralty both as least expensive and most convenient if a number of plates are intended to be printed. . . .

By various ways the coverage of navigational charts was widened. For his own work in the East Indies, Dalrymple in 1805 received 1 000 guineas for 100 impressions of forty-four plates and 380 plans printed by the Admiralty copperplate printer. (Hurd in 1808 was refused permission to engrave and publish his Bermuda work privately as it was prepared at public expense. It was an exception when, in 1831, Smyth received £500 for his prepared charts and plans of various parts of the Mediterranean.) The paucity and doubtful accuracy of the available material was, however, Dalrymple's persistent concern, and in February 1804 he advised on the draft of an Admiralty letter directing officers of H.M. ships to transmit hydrographic information.[1] There had been an earlier [*circa* 1760] letter that is such an illuminating example of a circular letter of the times and of the hydrographic data then relevant that it has been reproduced in Appendix B, 4. It mentions the use of 'Remark Books', of which some form had probably been long in use, and which have ever since been a continuing source of information to the department. The importance of Remark Books was stressed in a Naval Regulation of 1813, which noted with some severity a certain laxity in their compilation.[2] Meanwhile, in 1806, Dalrymple had, for example, been able to comment on a visit of the late Lord Nelson with new details of the Esquirques Shoal off Sardinia. Nelson's ships had had their navigational difficulties to overcome at both the Battle of the Nile and the action off Copenhagen. Moreover, in August 1801, when commanding the anti-invasion fleet off the south-east coast of England, Nelson needed the knowledge he had acquired in his early naval career of the Thames estuary. Nevertheless, it was Graeme Spence's help that enabled him to sail the *Medusa* through a channel off The Naze—to this day known as the Medusa Channel.

The Hydrographer provided advice on such matters as the routing of ships to the East and the importance of chronometers,[3] as shown by the loss of the *Athenian* off Cadiz, and also on how, following the grounding of the

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[1] Appendix B, 3.

[2] Bibliography 1, 4.

[3] The Board of Longitude was established by Act of Parliament in 1714 and accepted fifty years later the chronometer by Harrison. Cook carried a chronometer in 1772, as did later expeditions, but it was not until 1825 that regular supplies were made to H.M. ships. Concurrently with the advent of the chronometer, tables to make longitude determination by lunar distances practicable were published by Maskelyne, Astronomer Royal. (See also footnote[2] on p. 33.) The Board was dissolved in 1828.

Ruby, the Kentish Knock could be fixed by ships on a line of bearing with distances apart by sound from North Foreland. In 1808 he expressed the need for a survey from England to Holland, presumably for operational reasons, using anchored ships or buoys to form the stations of a quincunx. The latter was coupled with a proposal that Beaufort of the *Woolwich* should be employed, since he was, according to Dalrymple, an excellent observer and draughtsman. Neither proposal seems to have been followed up by the Board of Admiralty—still the authority for initiating surveys at home and abroad. As always, good grounds had to be shown, and as an example Their Lordships directed the survey of Dublin to be taken by Captain William Bligh of the Royal Navy in December 1800, at the desire of His Excellency Marquis Cornwallis, Lord Lieutenant of Ireland.[1] Three years later, Bligh was plotting the banks off the Scheldt for the benefit of the blockading fleet. This was the same Bligh who, despite the *Bounty* mutiny of 1789, transported bread-fruit plants from Tahiti to the West Indies and was later Governor of New South Wales for two years. Graeme Spence had succeeded his cousin Murdoch Mackenzie, whose uncle of the same name and with the title of Head Maritime Surveyor to the Admiralty had begun surveys in home waters in 1750.

Spence retired from active work in 1803, and though he continued in the Admiralty until 1811, the means described of effecting surveys in home waters then came to an end. Abroad, Flinders continued from 1801 his surveys of Australia, being armed with professional instructions from Dalrymple, who had published his *Essay on Nautical Surveying*. In 1806–7 Hurd surveyed off Brest and Ushant.

Greater accuracy and more extensive soundings to delineate underwater features were becoming increasingly necessary of hydrographic surveys. In this, the Mackenzies and Spence had pioneered the way with coastal triangulations and the use of the resection method for fixing afloat. The mathematics of resection had originated with Collins in 1674, and the use of Hadley's reflecting octant of 1731 for vertical angles of heavenly bodies was proposed for horizontal angles by Mitchell at the Royal Society in 1765. The octant became the sextant, which Mackenzie first used ashore in preference to the less-portable theodolite, although the development to the present-day instrument was gradual, reference Belcher's comment in his *Treatise on Nautical Surveying* of 1835: ' The sextant (or, which I prefer, the quintant, as enabling the observer to measure thirty degrees more) is, I am happy to say, in the possession of most young men capable of observing. . . .' By 1775, detailed surveys were being made without using compass bearings, but the ' station-pointer ', named such in the 1774 treatise of Mackenzie senior, did not provide the instrumental solution of the resection principle until 1785, and was not widely used until many years later. The same basic methods and instruments have continued into the present age of electronics. Robinson in his *Marine Cartography in Britain*[1] describes the foregoing developments and those of the preceding two centuries, including the use of beacons on sandbanks or afloat, an early form of patent log, and even an attempt to sound without a leadline.[2] He also recounts, in more detail than this chapter attempts, the progress of charting in home waters from surveys by the Admiralty, Trinity House, and others, carrying it as far as the end of the Beaufort period in 1855. Abroad, the methods introduced by Cook, which depended on frequent observations for geographical position and compass traverses along the coast, were to meet the requirements of the still largely exploratory surveys that continued into the nineteenth century.

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[1] Referred to in Professional Paper No. 13—Appendix C (*Note*).

On 10 October 1807 Dalrymple reported thus: ' In pursuance of the directions received in the Secretary's letter of 22nd May and permission on the 27th to purchase for the Hydrographical Office a compleat set of all charts published in England, I have at last made that collection, so far as is practicable, for many Plates have been destroyed, of which Plates, Impressions are no longer to be found but in private collections.' He questioned the accuracy of much of the material, and said, ' . . . that distinguished character, the late Admiral Kempenfelt, so long since as 1780 strenuously recommended that all publications of charts should undergo an official examination, and observed that the good being stamped with the authority of the Board, would direct the purchaser to avoid those erroneous charts, which, instead of serving to avoid dangers, too often fatally lead to them '. Dalrymple thus concluded that ships should not be without such charts so long as a caution accompanied them. The collection was listed in detail, and the charts, which numbered over a thousand, were grouped geographically to accord with the naval stations. The total cost was £168, and except for a small number of charts engraved in the office, the publishers were Arrowsmith, Laurie & Whittle, Heather, Faden, Steel, and Wilkinson. Unfortunately a list is missing of ' the plates engraved, and charts and plans prepared for engraving with some plates in Admiralty before the office was established ', which Dalrymple forwarded in November 1807.

In a further letter of that November, Dalrymple refers to his lack of experience of European and American seas, and his difficulty in deciding on respective merit (without any data to guide or support his judgment), and he begs ' leave to suggest that the most expedient mode of making a selection of charts for the use of H.M. Navy would be by a Committee of Officers who have the necessary experience, and it was for enabling the officers of H.M. Navy to point out where they knew, by experience, charts to be good or bad, that I recommended printing the lists'. The same letter proposes that foreign charts involving no security aspect should be engraved without amendment outside the office.

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[1] Bibliography 3, 7.

[2] See *Notes and Records of the Royal Society of London*, Volume 20, No. 1, June 1965, in which Margaret Deacon describes a particular activity in marine science by some of the Society's Fellows between 1660 and 1690. Robert Hooke's sounding-machines were outstanding—one used pressure difference, the other revolving vanes, and also a weight-releasing mechanism, a hydrometer and water-sampler. Observations of the oceans ranged widely, and the Record includes the opinion of the day on obtaining observations from mariners in the course of their voyages; or, in Newton's words, ' the Land would send mathematicians to Sea', an example being Halley's famous voyage of 1698–1700 in H.M.S. *Paramour*.

The Chart Committee (Captains Sir Home Popham, Thomas Hurd and E. N. Columbine) was accordingly set up on 27 November 1807. It promptly recommended the use of Atlantic charts by Arrowsmith and the ordering of copies of a chart of the West Indies, comprehending the Spanish main, from Mr Faden, engraver. Differences that arose between the members of the committee and Dalrymple about their terms of reference did not long delay them, and they made a first report on 29 February 1808. They sympathized with some of Dalrymple's difficulties and wrote of the 'necessity of establishing a system, which may enable the Government to offer to the British Marine, as well commercial as military, a collection of correct charts, adapted to the general purposes of navigation, in every quarter of the globe'. Details of the charts they had examined covered seventy-nine pages.

On 10 March came the main report of the committee. This report covered the 'Atlantic Ocean and Seas branching out of it' and therefore did not include the East Indies and the Pacific or books of directions. Schemes A and B of the report covered the supply of charts 'according to the usual stations, giving to each ship only (in general) those charts which belong to their Station' either (A) on linen or (B) in atlases. Schemes C and D were for 'an entire set to each ship down to a certain Rate'. Charts were listed by naval stations and author; publisher and price were also quoted. The number of copies required varied with the station, and ranged from 100 to 720. For the North Atlantic and the Channel, 720 copies of 34 charts were advised, with the comment: 'A considerable part of the charts has been for some time nearly engraved in the Hydrographic Office. It may be proper to give directions that the engravers shall finish these charts before any fresh work is undertaken.' The number of charts was only 180, but the total cost of scheme A, later to be adopted, was £11 140. Schemes C and D cost more than double. Estimates for the East Indies and the Pacific were added at £1 174 and £426 respectively, and in the former case it was noted that one hundred copies of Dalrymple's charts had already been bought.

A more serious difficulty between the Chart Committee and Dalrymple lay in the latter's extreme reluctance to permit the use of D'Entrecasteaux's[1] surveys, captured in an enemy ship and received by Dalrymple, who wrote of them 'as a secret and sacred deposit'. He went on: 'The originals were sent to France, the copies were made to prevent accident in the passage to France and have never been communicated except some of those concerning Van Diemen's Land under injunctions for keeping them secret. I have always kept the key of the drawer where they are in my own possession', adding, '. . . in such voyages of discovery the Public Faith has been mutual and even Bonoparte has given orders in triplicate for Captain Flinders' release.' The Chart Committee on the other hand referred to the 'expediency of obtaining from D'Entrecasteaux's valuable surveys such corrections as may be necessary for the more accurately placing of the principal points of those costs upon our general charts only, without entering into any detail of the particulars, or publishing a copy of D'Entrecasteaux's work . . . no impropriety in our using it in the very limited manner . . . particularly as every facility for their compleat publication has been liberally given to the French Government by the Admiralty about twelve years past when the entire originals were sent to France'.

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[1] D'Entrecasteaux had succumbed in August 1793 to scurvy, which took great toll of the expedition he was leading in a search for La Pérouse, whose ships had been last heard of in the South Pacific during 1786.

Dalrymple was overruled, and in May 1808, when informed of new plans requiring 'great and continual exertion on the part of Hydrographer', he was told, '. . . Their Lordships being fully aware that at your advanced period of life it would not be possible for you . . . deem it expedient to remove you'. Dalrymple was then seventy-one years of age. Mortified by his enforced retirement, he died three weeks later.

Dalrymple left an office in which he had set high standards of accuracy and integrity and in which there was a nucleus of engraved plates from which copies 'could be expediently and economically provided by the Admiralty printer instead of relying on purchases from various publishers'. The Hydrographer had been accepted as the adviser on all matters of navigation and surveying.

Much information about the charts published by the Admiralty in this initial period of the department's history may be obtained from the 'old copies', which, together with the surveyor's manuscript drawings, form such a remarkable collection of original documents in the department's archives. There was, however, no systematic organization at the start—not until 1823 was Becher appointed to make the first orderly arrangement of the documents. As one result, the National Maritime Museum, which acquired documents from various sources and individuals upon its foundation by Act of Parliament in 1934, now holds a number of the earlier old charts and surveys that are not to be found in the department's archives.

Moreover, when studying the early old copies it has to be appreciated that they are not necessarily proofs from the original copper plate at its date of publication as shown in the inscription at its foot. An early example of this inscription runs: 'Hydrographical Office, Published according to Act of Parliament May 25th, 1801, by A. Dalrymple Hydrographer to the Admiralty.' In 1823, after Hurd's time, the name of the Hydrographer disappeared and the wording became, 'Published according to Act of Parliament at the Hydrographical Office of the Admiralty', followed by the date. In about

1863, the Hydrographer's name (Washington) reappeared, and the inscription ran as it still does: ' London, Published at the Admiralty (the date), under the superintendence of . . . , Hydrographer.'

The Act was one of George III's—' for the more effectual Suppression of Societies Established for Seditious and Treasonable Purposes, and for better preventing Treasonable and Seditious Practices '. Under the Act, every printer had to include a name and address on his documents or be liable to a penalty of £20. Thus, the plates purchased from Dalrymple's collection before his hydrographership, and from certain private publishers for inclusion in the Admiralty series, may be identified by an inscription, such as ' Published according to Act of Parliament by A. Dalrymple Septr 5th, 1794 '.

The old copies are now arranged in series and sequences, a task taken up in 1934 under the direction of N. Atherton, chief cartographer, but not completed until 1958 owing to the intervening war years. The sorting of the earliest ones into chronological order had then, in the absence of notations of amendments to a plate, to resort to noting the appearance of a price or a number, which were known to have been adopted in 1819 and 1835 respectively; or perhaps a change in the value of the magnetic variation. Not until 1889 was the practice established of dating a plate at the bottom middle when a large correction was made, or at the bottom left for small corrections. From 1910 the date a proof was pulled appeared in the top-right corner, and then in 1920 the small corrections for information not essential for safe navigation were also dated, and since their identifying numbers were contained in a rectangle they were known as ' square dates '.

The publication of charts by the Admiralty doubtless began when the printing-press was installed in 1800 on Dalrymple's recommendation, but for the reasons given it cannot be determined exactly when the use of the hydrographical seal was authorized. At one period a hand stamp was used pending an addition to the plate by the engraver. The seal was not engraved on charts published in 1801, and the best available evidence indicates its first use on charts in 1803. The original design of an upright fouled anchor with the surrounding words ' Hydrographical Office ' has been increasingly decorated as later described, with the ' al ' ending removed in 1861. In 1964, the three fighting services were unified within the Ministry of Defence, the Admiralty and its Lords Commissioners ceasing to exist; but the Queen continued in her person the title of Lord High Admiral of the United Kingdom. Her seal of an upright fouled anchor, with or without the garter and Latin inscription, could no longer be used by former Admiralty departments. It was shown, however, that the anchor of the Hydrographic Department's seal[1] was not identical, and its continued use was permitted. At the same time, the continuation of the trade name ' Admiralty Charts ' was approved.

The earliest old copies to have been found are two at the National Maritime

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[1] See frontispiece.

Museum, both published on May 25, 1801. One is of the ' Coast of Ægypt from the Western Mouth of the Nile to the Tower of Arabs, laid down from various materials and observations in H.M. ships on that station in 1798 and 1799 ', that is, at the time of the Battle of the Nile. The topography of Alexandria was taken from French manuscripts. Of particular interest is the inclusion in some detail of the British, Turkish, and opposing French forces during the taking of Alexandria after a landing in Abu Qir Bay from 8 to 16 March 1801. The other is a large-scale plan of Alexandria Old and New Ports (Plate II), descriptions which have since been transposed; the channels through the reefs, which were buoyed, were shown. This depended on a French survey in 1798 by order of Admiral Bruyes done by Captain Barré of the frigate *L'Alceste* and by Citizen Lieutenant Vidal, the original having been taken when Vidal was captured in *La Courageux* by the *Centaur*. A note closely defined the difference between English and French feet and fathoms.

These two examples show that the practice was already established whereby the chart (m = 0·4 inch) was graduated while the plan (m = 3·2 inches) carried a scale of nautic miles. Both were oriented south upwards and showed a true meridian with points of the compass round a central point of the chart indicated by short lines outside the margins.

Another old copy in the archives is one published in the same year, Sept. 11, 1801, ' being a Plan of Plettenberg Bay on the South Coast of Africa '. In this case the original survey drawing is at the National Maritime Museum and a useful comparison may be made. The survey was done in July and August 1797 by Lieutenant Wm McL. Rice, R.N. It was oriented north upwards, and carried a scale of nautic miles (m = 1·4 inches), a geographical position, the variation, brief tidal information, a note that depths were in fathoms, anchorage positions, considerable coastal topography, and three views. The published chart shows how the cartographic interpretation had reduced the scale by about half and altered the orientation to west upwards, allowing a standard size of 12 by 9 inches. The chart, later numbered 640, is illustrated on Plate I.

A second manuscript survey by Rice in 1797, also at the National Maritime Museum, is of False Bay at the Cape of Good Hope and was made by order of Rear-Admiral Pringle. It describes Whistle Rock and its buoy in some detail and many coastal features are named. Rather surprisingly no published chart has been found of this important bay earlier than one of 1828 from surveys under the direction of W. F. Owen.[1]

A chart, later numbered 57, ' Chart of Part of the Coast of France from Cape Barfleur to Point Percee including St Marcou Islands by Lieutenant Samuel Thomas, Commander of H.M. Gun V. *Sandfly* under the orders of Captain Charles P. Price Senior Officer 1801 ', was published in 1803. It was an effective piece of surveying and cartography with its backed three-fathom line, low-water sand-dotting, cliff representation, anchor and tidal-stream symbols, and churches shown in elevation. It was also oriented west upwards and its military purpose in accordance with the Admiralty letter mentioned on p. 15 was shown by a note *in situ*: 'Field pieces and single guns along this coast about half a mile asunder.' It contained an administrative mention of a receipt from the captain to the office.

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[1] See p. 25.

Two examples may be quoted of plates purchased from Dalrymple, of which there are 272 in the archives. One published in 1794 of Port Hunter, is illustrated on Plate III. The other, later numbered 841, is of Nancowry Harbour published in 1792 from a survey of Captain Alexander Kyd, 1790. It referred soundings to L.W. springs with H.W. at nine o'clock of the days of full and change of the moon; arrows showed the direction of the flood-tide. It was graduated, and a true compass also showed magnetic north. This original copper plate of 1792 remained the basis of the Admiralty chart of Nancowry Harbour until it was replaced in 1959, no less than 167 years later! Here is evidence of the durability of copper plates, which, together with the facility they provide for embodying repeated corrections, explains the continuing use of copper engravings in chart practice.

As a final example of the period there is Chart 14, 'Owers &c. Harbours', published in 1804 from surveys by Murdoch Mackenzie in 1786. It was shown to have been engraved in the office by the entry, 'Palmer, Sculpt.'. It had a long descriptive note on tidal information and was graduated.

1808–1823

Hurd, who succeeded Dalrymple in May 1808, was the first of an unbroken line of Hydrographers selected from senior naval officers having surveying experience. He had a knowledge of the office, since he was attached to it while preparing his surveys of Bermuda for the engraver—an arrangement to be repeated for other surveyors for many years. He had also been a member of the Chart Committee.

War was in progress, and, after the failure of the Walcheren expedition, the Spanish rising against the French in 1808 permitted the deployment of British troops for their successful operations in the Peninsula. In 1812, war started between Britain and America owing to American objections to British restrictions on neutral commerce with Europe, and to Britain's claiming the right to search vessels for naval deserters. During the two-year war there occurred a seaborne expedition to Chesapeake Bay in 1814 employing seasoned troops from the Peninsula, and also the successful defence of Canada, during which there were naval battles on the Great Lakes. The fleets on the lakes were scrapped by mutual agreement in 1817, the boundary at the 49th parallel being decided a year later. The way was now open for the surveys of the Canadian lakes. These were carried out by W. F. Owen from 1815, and when his establishment was reduced in 1817 he left Bayfield to carry on. After war with France ended in 1815 at Waterloo, Britain retained Malta, Mauritius, the Cape of Good Hope, Dutch Ceylon, and Danish Heligoland, and became established in British Guiana. In the East, Raffles landed at Singapore in 1819 and opened it as a free port, its cession by a treaty with the Sultan following in 1824. In the same year, British and Dutch spheres in Malaya and the Archipelago were recognized, and the East India Company's posts in Sumatra were exchanged for Malacca. The end of the war also brought about increased international cooperation in putting down the slave-trade, the Royal Navy taking a major part in this operation in many seas.

In 1810, the Hydrographer's communication with the Secretary of the Admiralty ceased to be by formal letter, and was thereafter by departmental minute. Summarized details can be found in Admiralty digests, and the possibility exists of locating the original in the files.[1]

In June 1808 Hurd was directed ' to procure at the cheapest rate in his power and arrange sets of charts for H.M. ships agreeably to the Plan A of the Chart Committee with the addition of such general charts as in his judgment may be necessary for navigating the ships from the limits of the Channel to the several stations; and with respect to the sets of charts for the America and West India stations a further addition of such charts as he may think necessary in consequence of the ships on those stations frequently going from one to the other for the purpose of refitting at Halifax, &c. He is further to arrange to bind up the said sets of charts, as he shall consider most convenient and best adapted for their presentation. ' Six months later Hurd reported that 113 boxes had been issued, and he proposed arrangements for a number of boxes to be held by the commissioners at Portsmouth, Plymouth, and Chatham Dockyards, with plans for examining them periodically. This initiation of naval chart depots for the supply of the Fleet at home was promulgated in the Naval Regulations and Instructions of 1813 and 1824.[2] A suggestion by the Navy Board in 1815 that there should be chart depots at Malta and on other foreign stations was at that time thought unnecessary by Their Lordships. In March 1809, purchases of charts from the publishers were reported to have cost £4 574.

By various means Hurd sought new information through the Secretary of the Admiralty—for instance, one of H.M. ships at Cadiz under Collingwood was ordered to purchase sets of Spanish charts. Repeated requests for the originals of *The Atlantic Neptune* were sent to des Barres, then Governor of Prince Edward Island; and the negotiations for their deposit, coupled with a threat to stop his public pension, were finally completed in 1819. (More than a century later, in 1946, some sixty surviving des Barres plates were presented to the Governments of the United States and Canada.) The

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[1] Appendix B, 2.

[2] Bibliography 1, 4.

Board of Ordnance[1] was asked for Colonel Mudge's survey of England; and surveys of the Thames and the like were soon securely based on Ordnance Survey triangulation. Mr Rhodes was paid £50 for the copyright of his survey of Kerguelen's Land. He was at the time in King's Bench prison owing to his whaler's owners not having honoured the bills he had drawn. Trinity Board[2] was sent a questionnaire about the Thames estuary, and in return were supplied with impressions of Spence's survey of The Downs. Lieutenant Müller, of the Corps of Engineers and the King's German Legion, received 150 guineas for surveys of the mouths of the Elbe, Weser, and Jade. On security grounds, he was discouraged from further such work, but was instructed to purchase local charts when possible. In the war years, all captured charts were to be forwarded to the Hydrographer.

In June 1809 Hurd asked that a gunbrig or other suitable vessel should ascertain the true position of the Casket lighthouse, but, more important, wrote on 26 June: 'The present period of the year being adapted to the purpose of taking soundings and making Nautic Surveys I conceive it my official duty to entreat Their Lordships' attention to the sending a qualified person to lay down, or fix in their true relative position the numerous dangers extending themselves from the mouth of the Thames along the whole of the Eastern Coasts of England.' He instanced losses of life and asked Their Lordships to pardon his zeal for so strongly recommending the survey. On being directed to propose the means without delay, Hurd suggested William Chapman, master, in a convenient vessel with a good chronometer and spyglass, a sextant made by Troughton, a quicksilver horizon, and an improved azimuth-compass. Before the end of the year, Chapman had proposed a new vessel to replace the *Sorlings*, and following his death on 2 April 1810, Hurd recommended Thomas as his successor. In June, the Navy Board reported the *Gleaner* available at Deptford and she was established with two carronades and fourteen men,

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[1] A geodetic connexion of the Greenwich and Paris Observatories, instigated by the Royal Society and with the royal interest of George III, had led to the Hounslow base measurement in 1784. In 1791, the Ordnance Survey was founded to prepare a one-inch-to-one-mile map of Great Britain, largely as a measure of defence, and thus Parliament directed a trigonometrical survey, which was entrusted to the Board of Ordnance. By 1809 Williams and Mudge had triangulated most of England and Wales. The map sheets progressed northwards to cover the Midlands by 1840. The original office in the Tower of London was moved to Southampton in 1841. Royal Engineer survey companies were first formed in 1824.

[2] Trinity House received its royal charter in 1514, and authority to erect lighthouses and seamarks in 1566. There had been privately owned lighthouses from the Middle Ages, on which tolls were levied, and it was not until an Act of Parliament in 1833 that all lighthouses on the English coast came under Trinity House. The *Nore* was the first light-vessel, in 1732, followed by the *Dudgeon* and *Owers*. In 1795 there was the *Goodwin*, and in the French wars of Hurd's period, there were the *Nab*, *Galloper*, and *Gull*. As they were for Fleet use, the Admiralty paid for them and advised that they should be armed against the Dunkirk privateers. When hemp cables parted, the vessels made sail for shelter. The first lighted buoy laid by Trinity House was the East Oaze in 1880; buoys were still being made of oak as late as 1888.

Thomas as master. In November the Navy Board had a draft ready for building a surveying vessel in Deptford Yard. Their Lordships 'trusting that she would be ready by the 1 April', and Thomas proposing how her guns should be mounted on Colonel Congreve's principle, the *Investigator* was established on 11 April 1811 with twenty men and six carronades. Not long after, when Mr Triskey, master, asked who was in command he was told to 'obey Thomas in all things'—a precedent that established surveying officers in command of their ships. In 1811 Thomas surveyed the Yarmouth channels. In 1812 off Flushing he asked for more men, guns, and strengthened bulwarks while employed on the enemy's coast. Returning to home waters, he gave effect to Hurd's proposals by surveying, between 1813 and 1816, Liverpool Bay, the Kentish Knock and Long Sand, the Firth of Forth, Largs Bay, and the harbours of Holyhead and Howth, the last being at the request of the Post Office for the benefit of their packets.

In 1812, White in the *Fox* was completing Lockwood's survey in the Channel Islands. In 1813, again after Hurd had proposed the need for Channel surveys, Mr J. Foulerton, with the *Sydney* commissioned for his use, was appointed Superintendent of Surveys and Works on the Coasts and Harbours of Great Britain. After one of his reports at the end of the year, in which he incurred Their Lordships' displeasure for losing an anchor, Foulerton's name disappears, and in the following year, the *Sydney* was sent to the Newfoundland Station with Holbrook to command and receive instructions from the Hydrographer.

Abroad, surveys were initiated by admirals or senior officers of naval stations, and officers were appointed by them. Hydrographic records contain no details of the initiation of the survey of the Turkish Karamanian coast by Beaufort in the *Fredericksteen* between 1810 and 1812, although in July 1808 Hurd reported that sets of charts for Beaufort in the *Woolwich* and five flagships on the Mediterranean Station had been 'forwarded by coach to the Port Admiral at Portsmouth for the purpose of being sent aboard the *Woolwich*'. The expedition to the river Congo was sent by the Admiralty in 1816 on the instigation of Sir Joseph Banks (President of the Royal Society,[1] 1778–1820, and a companion of Cook in 1768), with Fitzmaurice as surveyor and master of the *Congo* under the orders of Commander J. H. Tuckey. Similarly there was the expedition to survey the coasts of Africa, commanded by W. F. Owen, an outstanding, determined, dedicated surveyor scornful of honours; and it may be presumed that he learnt of Flinders's surveying experiences when they were fellow prisoners of the French on Ile de France (Mauritius) from 1808 to 1810.

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[1] The inception of the Royal Society, in 1660 at Gresham College, Bishopsgate, came after a gathering of bodies from London and Oxford, formed some fifteen years earlier, and some others, had heard a lecture by Christopher Wren, then Professor of Astronomy at the college. The purpose of the Society was described as, to enlarge knowledge by observational experiment. (*A Brief History of the Royal Society*, Andrade, 1960.) Its impact on hydrographic survey, instruments, and methods of the eighteenth century is discussed in Robinson's *Marine Cartography*; and constant references to the Society will be found throughout this history of the Hydrographic Department.

The expedition in the *Leven* and the *Barracouta*, with officers such as Vidal, Mudge, and nephew R. Owen, set out in 1821 during Hurd's time; in fact Their Lordships' decision to dispatch it may well have been influenced by Hurd's report of 7 May 1814.[1] The expedition lasted five years, during which time fevers took such a toll of officers and men that when reporting the survey to the Royal Geographical Society in 1838 Washington remarked, '. . . [it] may be said to have been drawn and coloured with drops of blood '. The survey, which, according to Sir Clemence Markham,[2] was intended to benefit not only Great Britain but the whole civilized world, was done after tropical, or ' darkest ', Africa had been travelled by Mungo Park in 1795–1805, but before the journeys of Livingstone, Stanley, Speke, and others, which occurred some fifty years later.

In 1813, however, it was Hurd who recommended that Smyth, then about to join the flotilla operating off Sicily, should be furnished with the necessary instruments for surveying; and Captain Hall was directed to ' employ him so as convenient '. In 1815, Admiral Penrose reported on the Sicily work, and, in reply to an inquiry by the Secretary of State about the competency of Smyth for surveys of Malta and elsewhere in the Mediterranean, Their Lordships said they were so satisfied with Smyth's work that they intended so to employ him. Indeed, in 1817, Their Lordships directed that ' as a mark of their approbation and as an incitement to other officers to give their attention to similar pursuits they will direct a Selection of his Drawings to be engraved and published for the benefit of Captain Smyth '. In 1816, on the reduction of the army flotilla off Sicily, Admiral Penrose was instructed to appropriate a vessel to Smyth. Early the following year the *Aid*, renamed *Adventure* in 1821, was established with fifty men and sent out from England. Meanwhile, Lord Exmouth had presented Smyth to the Bey of Tripoli, who agreed to give Smyth every facility on a visit to Lebida for observing an eclipse of the sun, after which, in accordance with the approval given to Admiral Penrose's proposals, he was to continue with surveys of the Greek Archipelago and the Seven Islands, including ' the recovery of works of art '. From across the Atlantic there were reports of surveys on the Newfoundland and North America Stations by Holbrook and Lockwood respectively. There were also reports from Owen about the surveying service on the Canadian lakes, which was reduced in 1817 except for Bayfield. For his survey of New South Wales under the Colonial Department, King was given detailed instructions in 1817.

In 1816, soon after the *Aid* was established, the Navy Board was acquainted that, ' Their Lordships, intending to have surveys carried on in the British Channel and North Sea, direct them to fit two gunbrigs for this purpose, taking care to have a proper cabin for the use of the surveyors and communicating with the Hydrographer on the subject. The vessels to be ready by the 1st February 1817 and to have only two guns for signal guns '. The vessels selected were the *Protector* and the *Shamrock*; White was put in command of the former, and Howell was proposed by Hurd for the latter as he was ' a qualified mathematician and draughtsman '.

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[1] See p. 27.

[2] Bibliography 3, 6.

This development followed directly from a letter of 12 October 1816, written by Hurd to the Secretary, which contained a detailed report on the present situation of the Hydrographical Office and the various improvements of which it was 'susceptible'. Only the digest of this letter has survived; it reads:

> The Captain in the first place suggests with a view of defraying a part of the expenses of the department that after a plate has been engraved and a sufficient number of charts struck off for Naval Uses, that the remaining impressions be disposed of at a moderate price for the benefit of the Trading Interest and the amount of sales carried to an office account in aid of its annual expenses: and secondly submits the expediency of selecting a certain number of officers well acquainted with the science of maritime surveying and forming them into a distinct and separate corps something similar to that of the Engineers of the Army and transmits a list of officers entitled to consideration for such employment. He at the same time transmits a copy of his letter of the 7th May 1814 forwarding a list of various places where the Hydrographical Information is most wanted with papers of reference describing those wants and also a memoir of Major Rennel on the imperfect state of the Hydrography of the Gulf stream with a plan. Observations of Mr Barrow (Second Secretary of the Admiralty)[1] on the various papers are likewise enclosed.

The enclosure of 7 May 1814 is given here in full as being the first of the reports on the state of hydrography which the Hydrographers were to prepare from time to time for many years:

> The return of Peace[2] to this Country makes me consider it as an official duty to represent to the Lords Commissioners of the Admiralty the great deficiency of our Nautical knowledge in almost every part of the World, but more particularly on the coastline of our own Dominions, and also with the hopes that the present favourable moment for remedying these evils will be made use of, by calling into employment those of our Naval Officers, whose scientific merits point them out as qualified for undertakings of this nature—of which description of Officers there are I am happy to say many who stand eminently conspicuous.
>
> Nearly the whole of the China and Eastern Seas included between

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[1] Sir John Barrow (1764–1848) was appointed Second Secretary to the Admiralty by Lord Melville when he became First Lord on Pitt's return to office in 1804. Occupying the post with hardly a break for forty years, he was associated with the proposal in 1817 for voyages to discover the North-west Passage (see p. 34) and with the formation of the Royal Geographical Society (see p. 46).

[2] Peace negotiations were in progress but Napoleon's escape from Elba and the ' Hundred Days ' culminating in Waterloo were yet to come.

Kamchatka and Van Diemen's Land, together with the Philippines and Islands on the western coast of Sumatra are unknown to us particularly a vast extent of coast on the north and west sides of New Holland, which is supposed to be sterile and without fresh water, but which supposition I have no doubt upon a proper examination will be found to have been grounded in error, and that many large Rivers, Harbours and interior waters remain to be discovered in this unexplored Country.

Of the greater part of the Sea Coast forming the Eastern side of the African Continent from the Red Sea, to the Lagullus Bank, at its southern extremity we are ignorant, and also of the Western Coast from about fifteen degrees South, to Cape Spartel, we have but a very imperfect knowledge. Many Islands and Dangers are also laid down on the Charts to the southward and eastward of the Cape of Good Hope, to the great terror of Navigators, the existence of which are doubted—all these it would be a very desirable object to examine into, and have their reality either ascertained, or their position on the Charts expunged therefrom.

The Eastern side of the South American shores from Cape St Mary, near the entrance of the River Plate to Trinidad, one of the West India Islands, at both which places the Spanish observations seem to have been discontinued, is erroneously laid down in the Charts and Maps of that Country and therefore want rectifying. A knowledge is also wanting of various situations and harbours therein, just growing into use and notice, such as St Luiz Maranham and various others.

In the Mediterranean where so many of His Majesty's Fleets and Ships have been employed during the whole war, our knowledge is very limited, particularly on the Southern Coasts thereof, from Algiers to Alexandria and from thence along the Syrian Shore to the Gulph of Scanderoon, where Captain Beaufort's late survey ended. Likewise of the Coast and Islands in the Archipelago, together with the whole Eastern side of the Adriatic, of which Seas our ignorance is so great as to leave us without any information as to the real extent or width of its entrance from the Mediterranean.

But the most remarkable of our deficiencies for a great Maritime Nation is our want of a competent knowledge of the contour and real geographic situation of many parts of our own shores, such as the Firth of Forth and of the whole northern and western Coast of Scotland from that place round to the Isle of Man, as well as of the Shetland Isles, and I am also sorry to observe that even our knowledge of the Irish Coast is equally deficient being confined generally speaking to Dublin and Cork Harbours.

An examination or search after the several Islands and Vigias marked in all of the old charts of the North and South Atlantic Oceans, but whose reality or existence have long been doubted, would be a very desirable object and I am fully persuaded that most of those dangers will be found Ideas and have had their origin in Ice Islands, which being unexpectedly met with at sea and under particular points of view, as well as of various distances have appeared to the alarm'd Navigator in the shape both of Land and breakers or have otherways arisen from Reckonings very badly kept, of which latter I beg to quote an Instance within my own observation—In the year 1789 having been ordered to make a Nautical Survey of the Bermudas, all my endeavours were unsuccessfully used to discover a danger laid down in the old charts of those seas under the title of a false Bermuda but found that the Idea of their existence originated during the early periods of navigation, from some vessels on their homeward bound passages having fallen in with

> the dangers surrounding those Islands, which dangers extend on their Northern side to a considerable distance from the land, and on the extreme of which is situated a bed of Pinnacle rocks always above water, these rocks having been seen when the land was enveloped in a very thick haze caused the error, and they were immediately marked on the chart agreeable to the Latitude and Longitude by account, which in those early days was always erroneous.
>
> As a proof that the above conjecture is well founded all the charts place these Rocks right as to Latitude, but at least five degrees wrong in Longitude to the Eastward, which error was probably caused by their having passed through the Gulph stream without making a sufficient allowance for its effects.
>
> Their Lordships having lately sent out Surveyors to the Newfoundland and American Stations renders it unnecessary for me at this time to enumerate our deficiencies in those parts of the World.
>
> In acquiring the Nautical knowledge here recommended, much good might also result therefrom in other points of view as an excellent opportunity would thereby be afforded for the exertions of abilities both scientific and commercial, by uniting as Companions of their researches, persons of the description who of course would become accountable to the Nation for all the knowledge they might thereby acquire. At all events such an undertaking would keep alive the active services of many meritorious officers whose abilities would not be permitted to lie dormant, whilst they can be turned to National benefit and would also be the means of acquiring a mass of valuable information that could not fail of being highly advantageous to us in any future War, and would otherways redound to the Credit and Glory of this great Maritime Empire, whose flag flies triumphant in every part of the World.
>
> I have the honor to be Sir,
>
> Your most obedient and most humble Servant
>
> THOMAS HURD Hydr

In March 1817, one more vessel, the *Congo*, on her return from an ill-fated expedition to the river Congo, was established for surveying with Fitzmaurice as master, and at this time the Navy Board was instructed to keep a separate list of surveying vessels and consult the Hydrographer before appointing a master or second master. Then, on 7 January 1817, a Board minute established special rates of pay for officers in the surveying service: commander twenty shillings, lieutenant and masters fifteen shillings per diem, in addition to the pay of their rank in the vessel in which they might be employed. It had been the practice for some years to pay allowances on individual application; and although Hurd remarked in 1819 on the inadequacy of the 1817 rates, several years passed before a satisfactory scale was finally adopted.

Thus the Royal Navy's surveying service came into being and its pattern has continued unchanged to the present day. Hydrographers have advised the Board of Admiralty on surveys, and surveying ships and their officers, and have fostered the Navy's collaboration with the Royal Society and the geophysical sciences. Officers in command and in charge of surveys have received their instructions from the Hydrographer via the Board. The ships have been administered by the commanders-in-chief of the various stations, and have executed their urgent surveying requirements in war and peace. Such additional commitments have been reported to the Hydrographer in order to provide him with the possibility of fitting them into the over-all, world-wide programme designed in the Admiralty in consultation with Military Branch and the Naval Staff.

For various reasons, the surveying service had its vicissitudes arising out of a conflict of opinion on the value of surveying by comparison with other naval tasks, especially in peacetime. As Richards wrote in his *Memoir* of 1868[1] about the early development of the Hydrographic Department and the surveying service afloat:

> It was a kind of hybrid institution, the one branch of it inviting as it were the opposition of the civil element at Whitehall, the other calculated to encounter the ill will of the authorities afloat, from the circumstance that it was necessary the officers composing it should in a measure be independent of their authority; and yet this state of things is quite comprehensible without imputing blame anywhere; . . . there were moreover the means wanting, involving no inconsiderable outlay, and it is scarcely surprising that rulers, who could not have seen their way to the great results which have since been attained, should have been chary of providing them.[2]

Methods and equipment developed but slowly, though in 1818 there was mention of a surveying floating beacon newly invented by Mr Dickinson. A number was supplied to ships, but Thomas was soon to report that these had broken in a gale of wind.

In the office, the business inexorably increased, and the war years

> called for the utmost exertion of the Hydrographer and of every individual under his employment in order to keep pace with the numerous demands on the Office, as well as to perform the indispensable and current duties therein keeping up the various and constant supplies necessary to the outfit of His Majesty's ships, and in the formation and correction of New and Old Charts adapted to the several Stations or Parts of the World in which they were likely to be employed.

It was concern for the care of the accumulating original manuscript documents that in fact occasioned these words in a report by Hurd on 18 September 1819, which referred to various directives on the matter by the Secretary as long since as 1810. Hurd was able to say that all the charts applicable to the naval service were in excellent order, and that lack of space was the greatest obstacle—the allocation of the Model Room for other purposes had meant moving the manuscript documents back to their original situations. There followed a Board minute (present, Lord Melbourne, etc.) of 16 November 1819:

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[1] Appendix C, 4.

[2] Since details of surveying activity for the period covered by this chapter are fully recorded in Parts I and II of Dawson's *Memoirs of Hydrography*, further mention of them will only be in general terms. See also Tizard, *List of British Discovery and Survey Vessels to 1900.*

> Their Lordships being extremely anxious that the present opportunity of Peace should be employed in the advancement of Hydrographical knowledge and in the arrangement and classification of the information which may exist in the office are pleased to direct: quarterly reports on surveying activity, the display of every new work to the Board, the adoption of the same principles of custody and arrangement for official records as in other departments placing responsibility on the Clerk of the Record Office but giving Hydrographer authority to visit, examine, extract and make use of these documents in the fullest manner he may find necessary for the Public service, the arrangements for chart boxes to be continued as heretofore, and lastly in the general use of navigation as well as to meet part of the expenses of the Hydrographical Department, the Secretary is to take such measures as he may judge proper for enabling the Public to purchase Admiralty Charts at reasonable prices.

Hurd had at last obtained agreement to the sale of charts to the mercantile marine, but the arrangement for the vitally important original documents was not to be final. Meanwhile, the major task of supplying the Fleet with charts had been increased in 1809 when the Hydrographer was also made responsible for the supply of timekeepers. Inevitably, expenses rose, and the periodic preparation and submission of imprests as well as annual accounts were a regular feature of the records. At the end of the war in 1815, the Hydrographer was informed that a mere £1 500 was to be voted for his department. This provides further evidence that Croker, Secretary of the Admiralty from 1808 to 1830—formative years for the department—, was particularly and continually anxious to limit the further cost to the Navy Vote that followed on the greater demands that marine authorities, scientific bodies, or navigators themselves made on the services the Hydrographic Department and the naval surveyors could provide. In fact, in 1818, Hurd's imprests for office wages and expenditure were running at £5 000 per annum.

Details of the established and temporary staff with which Hurd met the many demands are not clearly shown in the records. Notes by Parry in 1827[1] confirm that the original engraving staff had been gradually replaced by draughtsmen—Higgins (1800), Michael Walker (1809) and his brother Thomas Walker (1810)—and that besides Walker senior and Nares, clerk, there had at some period been an additional clerk, Bailey, and two chart-packers, Brown and Anderson, ' the one deceased and the other dismissed '. At most there were four draughtsmen, two clerks, and two packers. Parry's notes remark that all engraving had for many years become concentrated outside the office in the firm of Messrs Walker. Richards's *Memoir* in 1868, in part derived ' from the fragmentary notes of one connected with the department from its earliest days, and until lately living [presumably M. Walker] ', attributed the change-over to draughtsmen to the wartime need to produce special charts hurriedly for operational purposes. The *Memoir* also declared that, between 1816 and 1820, large additions were made to the stock of

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[1] Appendix C, 4.

Admiralty plates by purchase from the private publishers to whom the surveyors had sold the copyright of their work. The story of the purchase in 1809 of Dalrymple's plates as scrap-metal is covered by Gould.[1] Purchases of charts certainly fell from £5 000 in 1809, when regular supplies to the Fleet began, to £1 000 in 1814. The purchases were, however, to be necessary, though in decreasing quantities, for a number of years in order to supplement the charts being engraved from the surveys, foreign originals, or drawings compiled in the office, all of which were printed in the Admiralty.

Some interesting examples of charts published in Hurd's time are as follows: Chart 79 'Ferrol &c., by Don Vincent Tofina de S-Miguel, Brigadier in the Spanish Naval Army', which had been published in 1801 by Faden. It now carried a note, 'Approved by the Chart Committee', and an inscription, 'Bought of Faden and published at the Hydrographical Office of the Admiralty, May 1823'. It noted that the Spanish fathoms were one-twelfth shorter than the English fathom. Chart 30, 'Plymouth Sound',[2] published in March 1822, shows vertical hachuring very thickly used over the land, buildings diagonally ruled in, symbols for trees and scrub, L.W. sand and finer mud stipple, rock and cliff representation, an open selection of soundings in fathoms and fractions, +s inside a danger-line, the three- and four-fathom lines by dots, with the former backed and many leading or clearing lines. A linear scale was in nautic miles. A small-scale chart (Chart 4) of the English Channel, graduated and showing the sides of the triangulation, was without topography and illustrated only a danger-line and lines surrounding large areas with the same nature of the bottom. Ebb and flood arrows radiated from a number of positions. Both charts were inscribed 'J. Walker, Sculpt.'. Many of the cartographic styles of that day are in fact recognizable on a modern Admiralty chart.

The Hydrographer still had no naval assistants, although in the office there were naval surveyors drawing charts from their surveys, and according to Dawson,[3] Hurd was given advice on the formation of the surveying service by W. F. Owen and Heywood. The staff was, however, temporarily supplemented by two French naval officers. According to Gould, M. Ropel served for a year in 1801, and since he was later to be the French Hydrographer, a good liaison between the two departments was fostered. The other was St Amand, whose employment was proposed by Hurd in 1812, 'expecting to derive great advantage from his talents in various ways', for the construction of charts on a special principle in high latitudes. In St Amand's case, approval was for employment by, rather than in, the office, for wartime-security reasons. In fact, according to Gould, little was achieved in the seven years of St Amand's attachment.

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[1] Appendix C, 4.

[2] The front end-paper illustrates the first edition of this chart in 1803, at which date the cartography was considerably less detailed. The back end-paper shows the edition of 1916.

[3] *Memoirs of Hydrography*, Part I, p. 57.

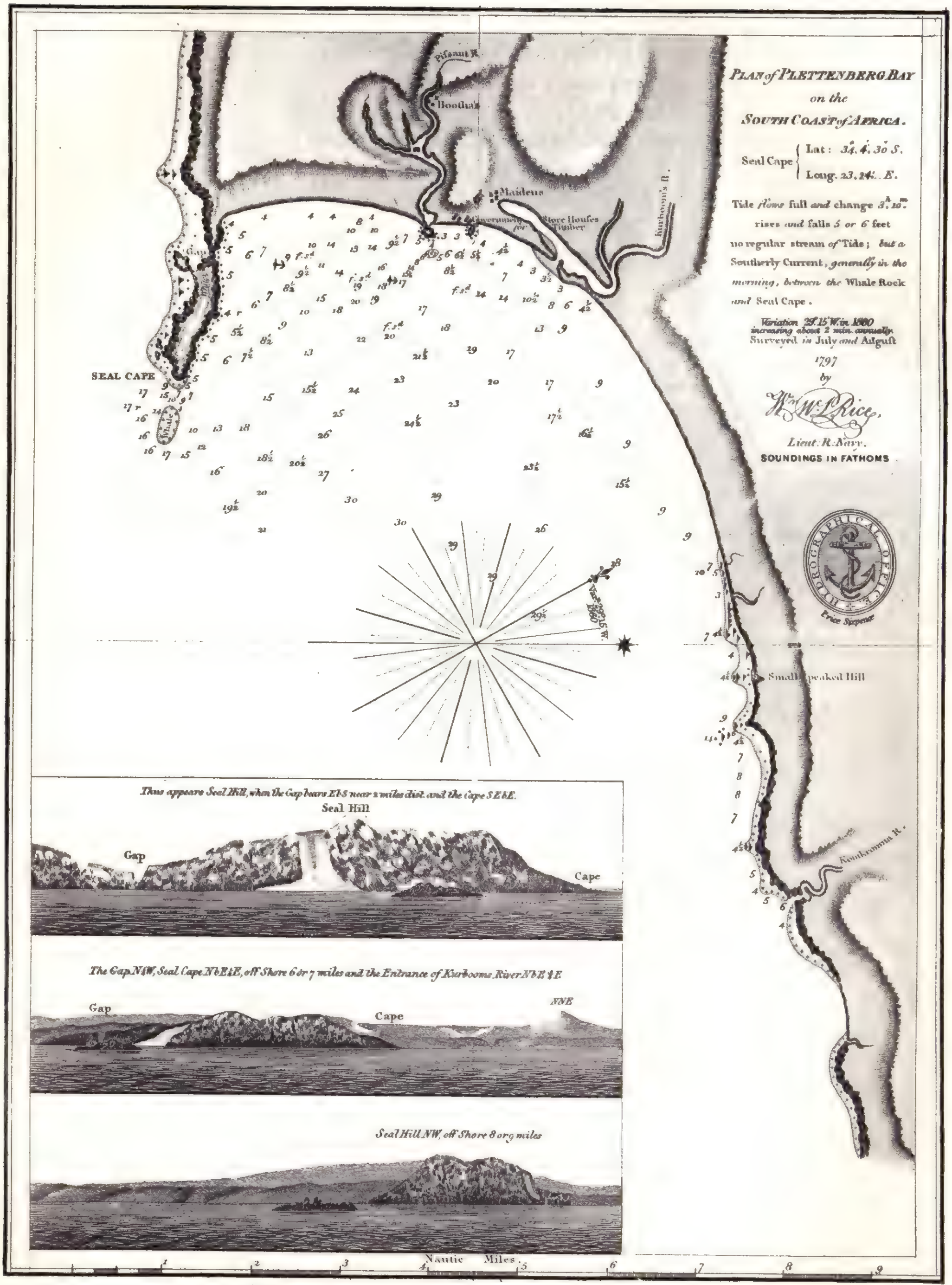
EARLY ADMIRALTY CHARTS

I *Plettenberg Bay*
II *City of Alexandria*
III *Port Hunter*

Plates I, II and III, following, are reproductions from some of the earliest charts in the Admiralty series. These charts are preserved in the Hydrographic Department's massive and immensely valuable archives, which are also the source of the charts of Plymouth (reproduced on the end-papers), the Loch Awe fair survey chart (reproduced as Plate X), and the survey and chart of Alexandria approaches (Plates XII and XIII).

The reproduction of such documents, because they are large and much used, allows only a portion of the chart, on a reduced scale, to be illustrated. Modern reproduction methods have been skilfully used in the preparation of these examples by the Hydrographic Supplies Establishment, Taunton.

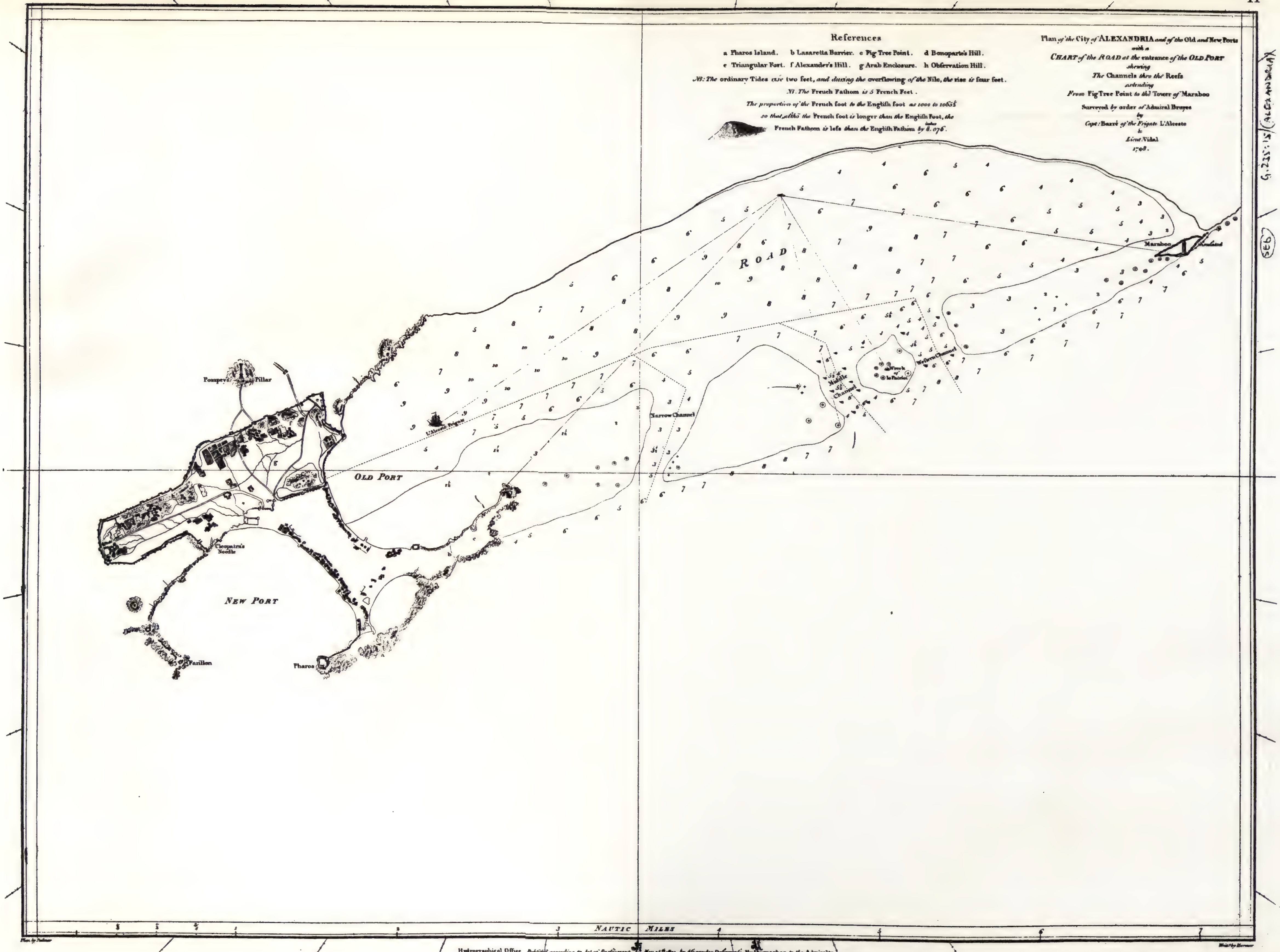
I


PLAN of PLETTENBERG BAY
on the
SOUTH COAST of AFRICA.
Seal Cape { Lat: 34°. 4'. 30" S. Long. 23. 24'.. E.
Tide flows full and change 3h. 10m.
rises and falls 5 or 6 feet
no regular stream of Tide; but a
Southerly Current, generally in the
morning, between the Whale Rock
and Seal Cape.
Variation 29°.15' W. in 1800
increasing about 2 min. annually.
Surveyed in July and Auguſt
1797
by
Wm. W. L. Rice,
Lieut: R: Navy.
SOUNDINGS IN FATHOMS.
HYDROGRAPHICAL OFFICE
Price Sixpence
Piſsant R.
Boothas
Maidens
Government Store Houſes for Timber
Kurboom's R.
Keurbooms R.
Gap
Whale
SEAL CAPE
f.s.d
Var. 29°.15' W. 1800
Small peaked Hill
Thus appears Seal Hill, when the Gap bears E b S near 2 miles dist. and the Cape S E b E.
Seal Hill
Gap
Cape
The Gap N ¼ W, Seal Cape N b E ¼ E, off Shore 6 or 7 miles and the Entrance of Kurbooms River N b E ¼ E
Gap
Cape
NNE
Seal Hill NW, off Shore 8 or 9 miles
Nautic Miles
1
2
3
4
5
6
7
8
9

Hydro-graphical Office *Publiſh'd according to Act of Parliament Sept. 11. 1801. by A. Dalrymple* Hydrographer *to the* Admiralty
Sold by J. D. Potter Agent for the Admiralty Charts 31 Poultry & 11 King Street Tower Hill.

640

G.235.15 (ALEXANDRIA)
56



Plan *of the* City *of* ALEXANDRIA *and of the* Old *and* New Ports
with a
CHART of the ROAD at the entrance *of the OLD PORT*
shewing
The Channels *thro the* Reefs
extending
From Fig Tree Point *to the* Tower *of* Maraboo

Surveyed *by* order *of* Admiral Bruyes
by
Capt: Barré *of the Frigate* L'Alceste
&
Lieut: Vidal
1798.

References

a Pharos Island. b Lasaretta Barrier. c Fig Tree Point. d Bonoparte's Hill.
e Triangular Fort. f Alexander's Hill. g Arab Enclosure. h Obſervation Hill.

NB: The ordinary Tides *rise* two feet, *and during the* overflowing *of the* Nile, *the* rise *is* four feet.

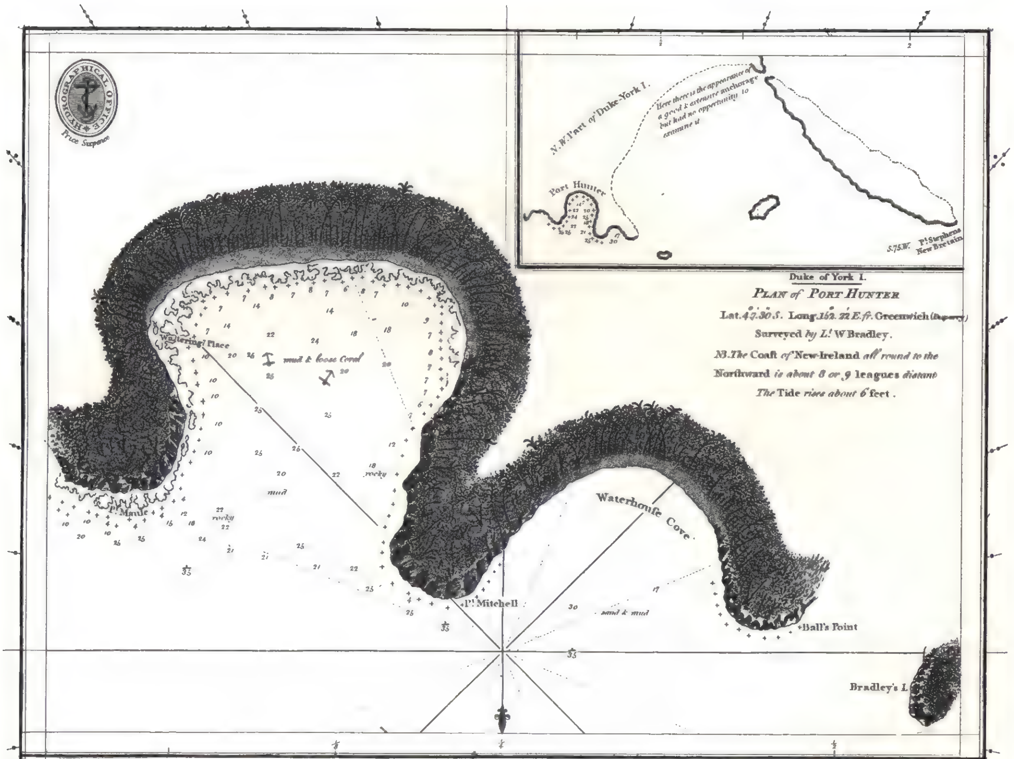
NB. The French Fathom *is 5* French Feet.

The proportion of the French foot *to the* Engliſh foot *as 1000 to 1065½*
so that, altho the French foot *is* longer *than the* Engliſh Foot, *the*
French Fathom *is* leſs *than the* Engliſh Fathom *by* *inches* *8.076.*

Plan by Palmer — *Writ by Harmer*

Hydrographical Office *Published according to Act of Parliament May 28th 1801, by Alexander Dalrymple* Hydrographer *to the* Admiralty

HYDROGRAPHICAL OFFICE
Price Sixpence



N.W. Part of Duke-York I.
Here there is the appearance of a good & extensive anchorage but had no opportunity to examine it
Port Hunter
S.75.W. Pt. Stephens New Britain
Watering Place
mud & loose Coral
mud
rocky
Pt. Maule
Waterhouse Cove
Pt. Mitchell
sand & mud
Ball's Point
Bradley's I.

Duke of York I.

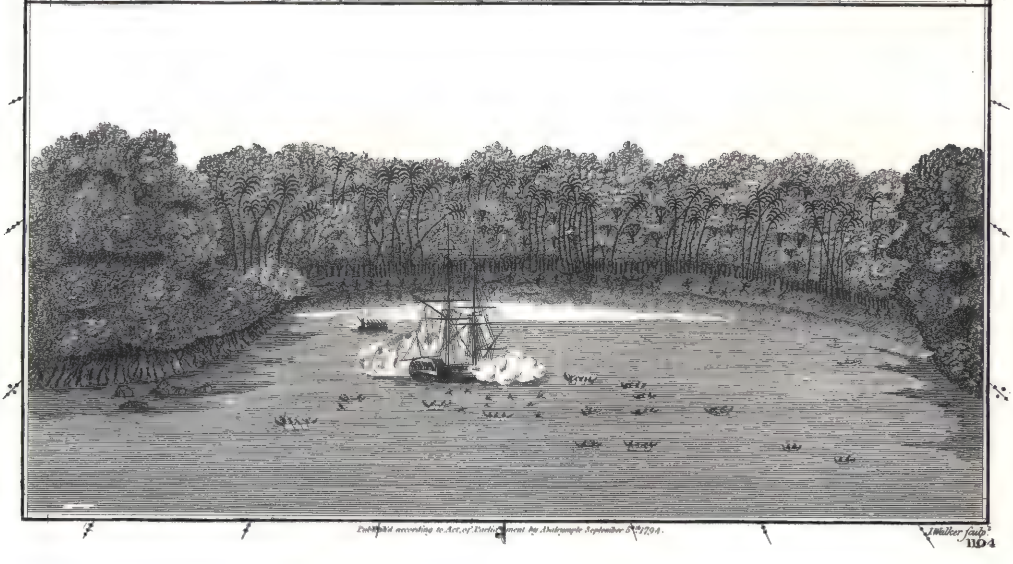
PLAN of PORT HUNTER

Lat. 4°. 7'. 30" S. Long. 152°. 22' E. fr. Greenwich (by acct.)

Surveyed *by* Lt. W Bradley.

NB. The Coast *of* New-Ireland *all round to the* Northward *is about 8 or 9* leagues *distant*

The Tide *rises about 6* feet.



Publish'd according to Act of Parliament by Dalrymple September 5th 1794.

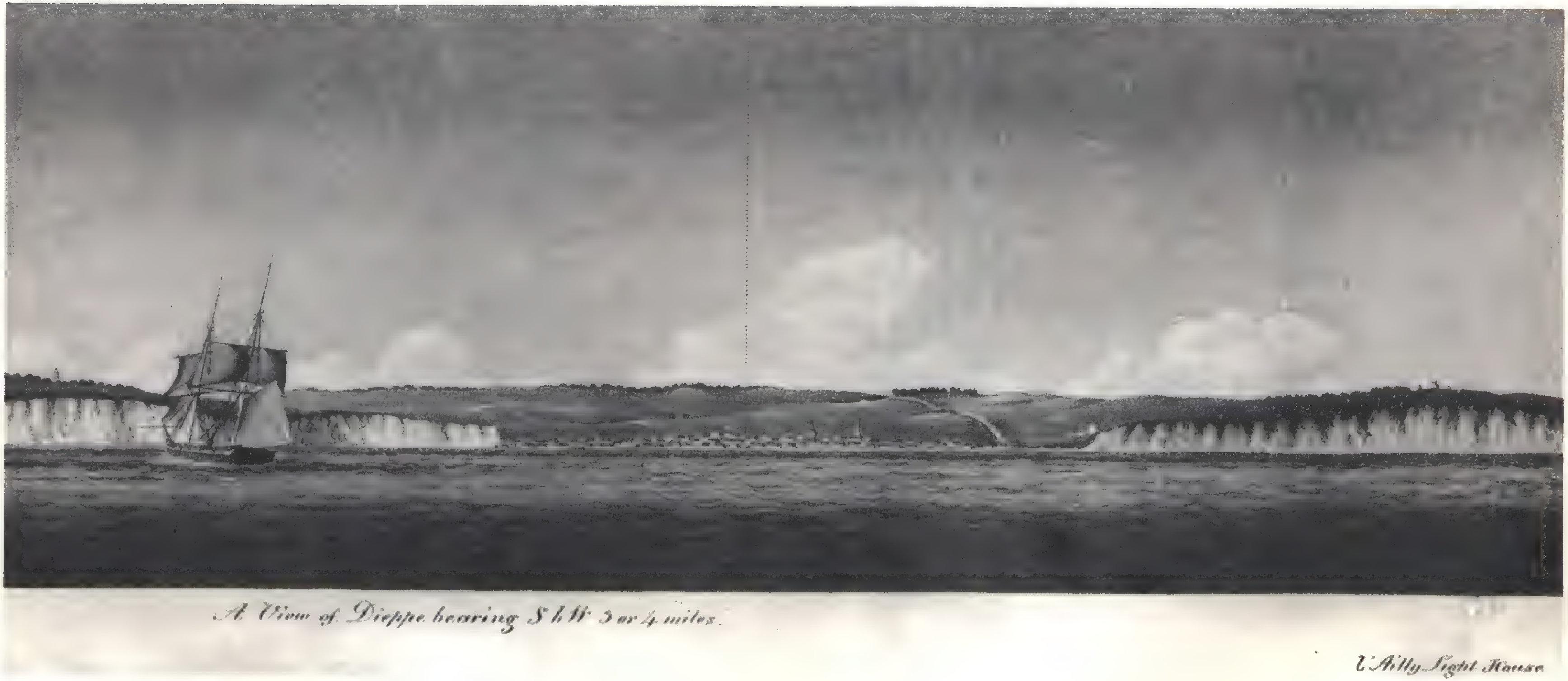
J. Walker sculp.

Views of Harbours and Coasts

IV *Dieppe*
V *Nisero Island*
VI *Harwich*
VII *North Foreland*
VIII *Nandi Harbour*
IX *Amoy*

The department's archives hold a fine collection of water-colour sketches and views with which surveying officers, or artists specially embarked, e.g. on Cook's voyages, have illustrated their surveys. The need for views was mentioned in an Admiralty circular letter of *circa* 1760 (see Appendix B, 4). Some were engraved for publication as separate documents and inclusion in the early chart catalogues. Alternatively, a chart carried a view, and later some were reproduced in Sailing Directions. The views are here reproduced in monochrome.

IV

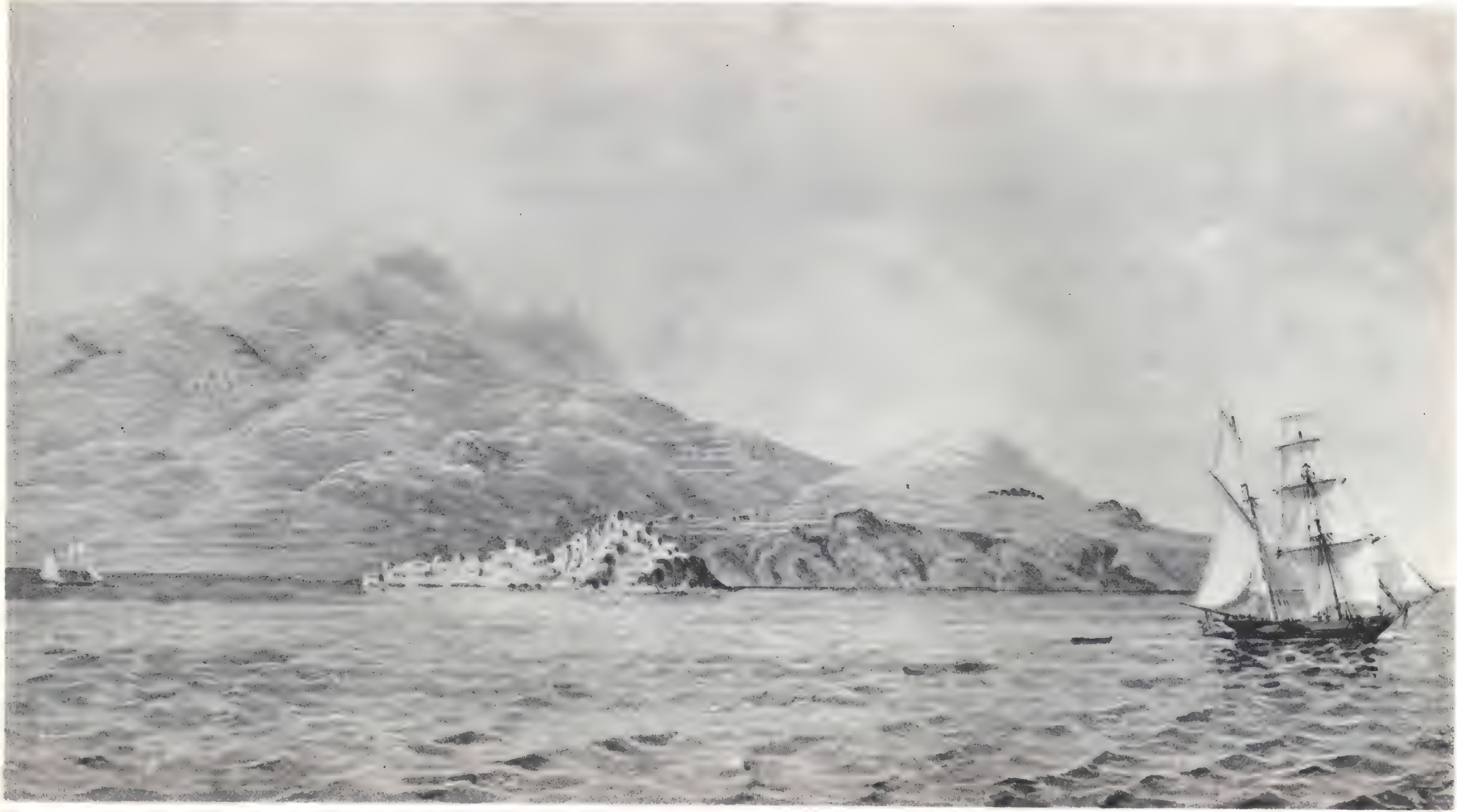

A View of Dieppe bearing S b W 3 or 4 miles.
L'Ailly Light House

The original is a sepia wash-drawing

Artist unknown

DIEPPE

V

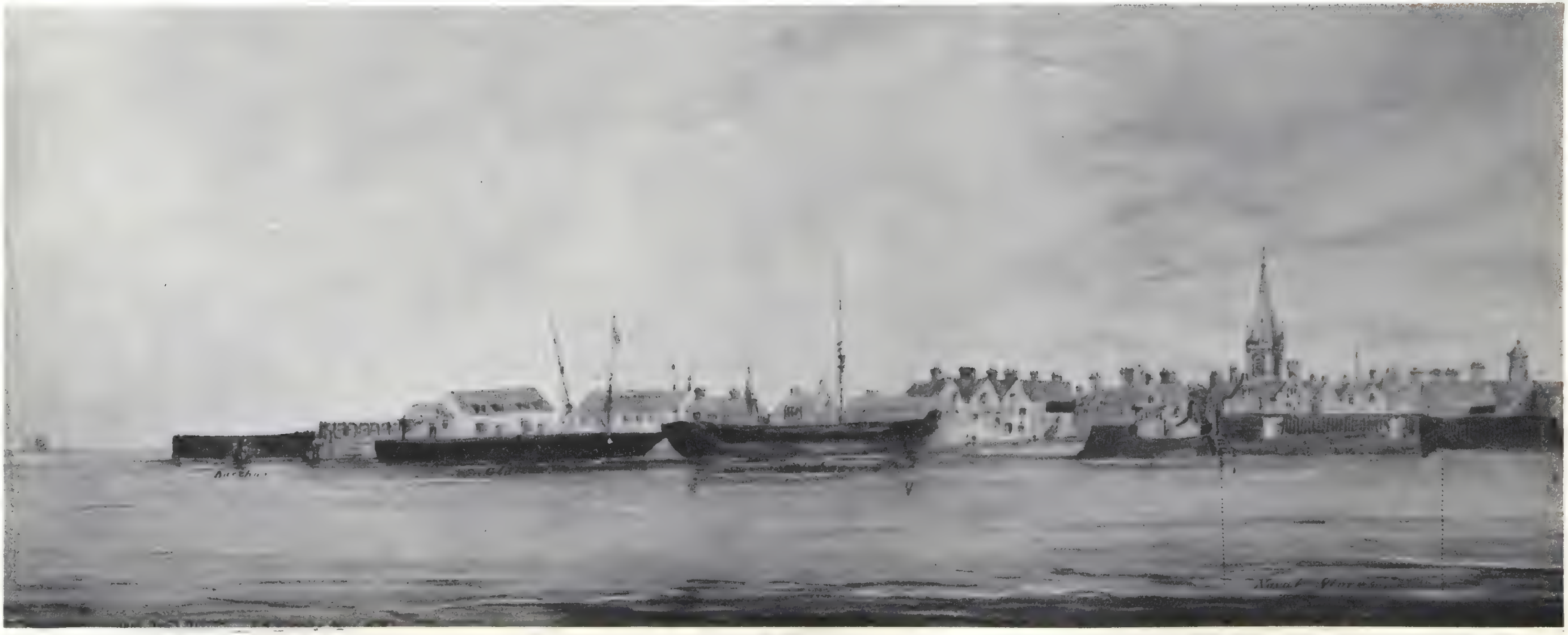


The original is a grey wash-drawing

Lieut T. S Brock 1834

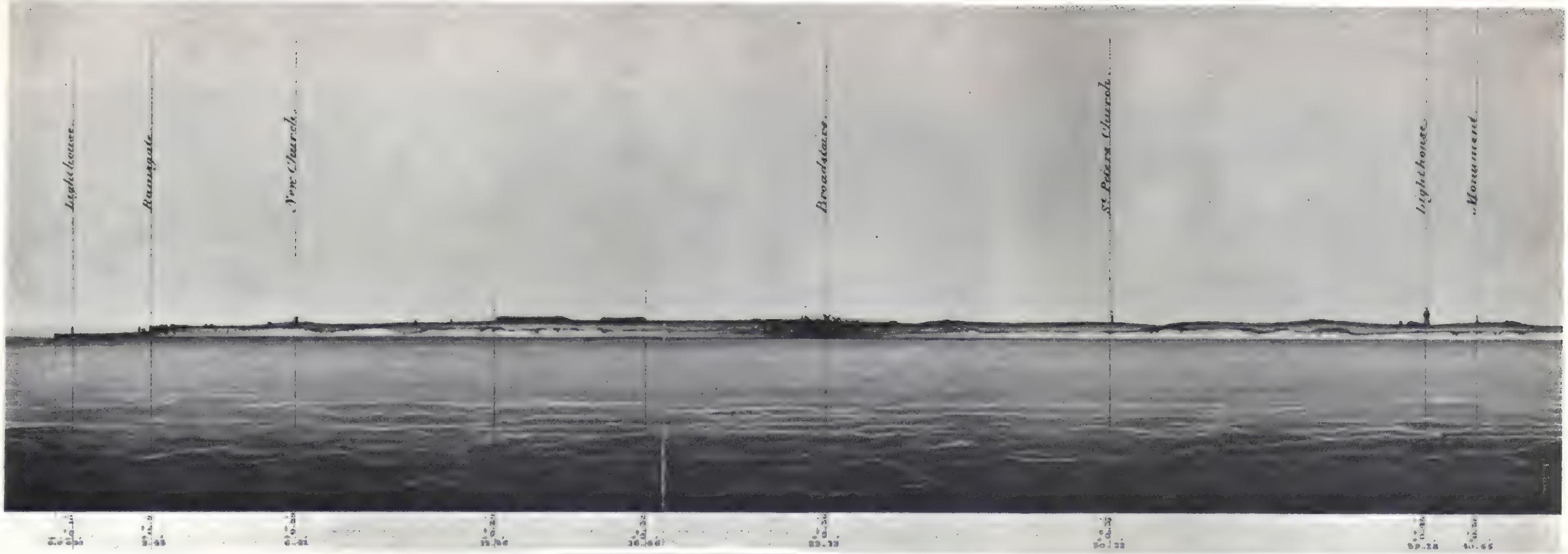
NISERO I^{d}

VI



The original is in water-colour

HARWICH



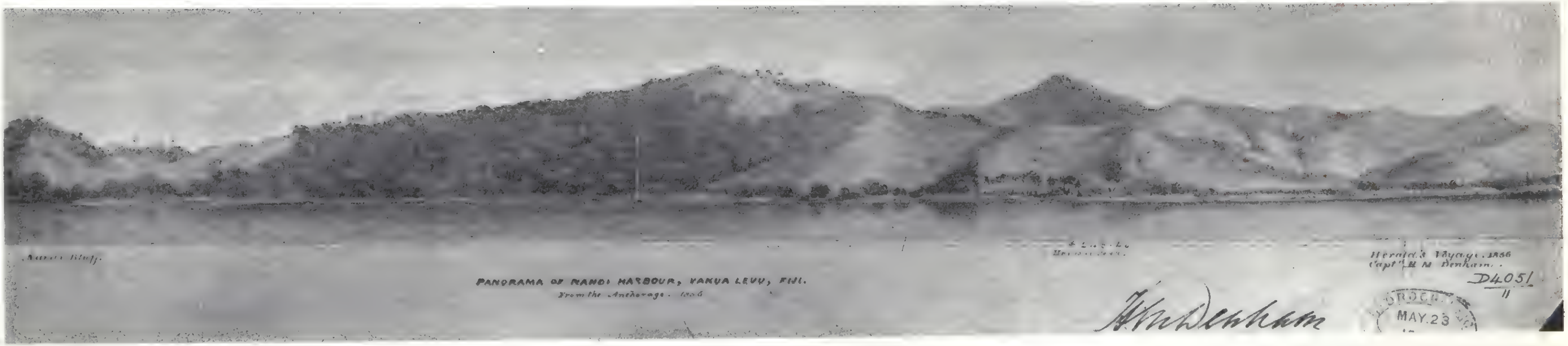
View of the North Foreland the Lighthouse bearing 6 Mag^{s} Miles.

Angles for position. Ramsgate. New Church 6..6 Broadstairs. Mill 15..21 St. Peters Church 25..35 Lighthouse 32..45.

The original is in water-colour

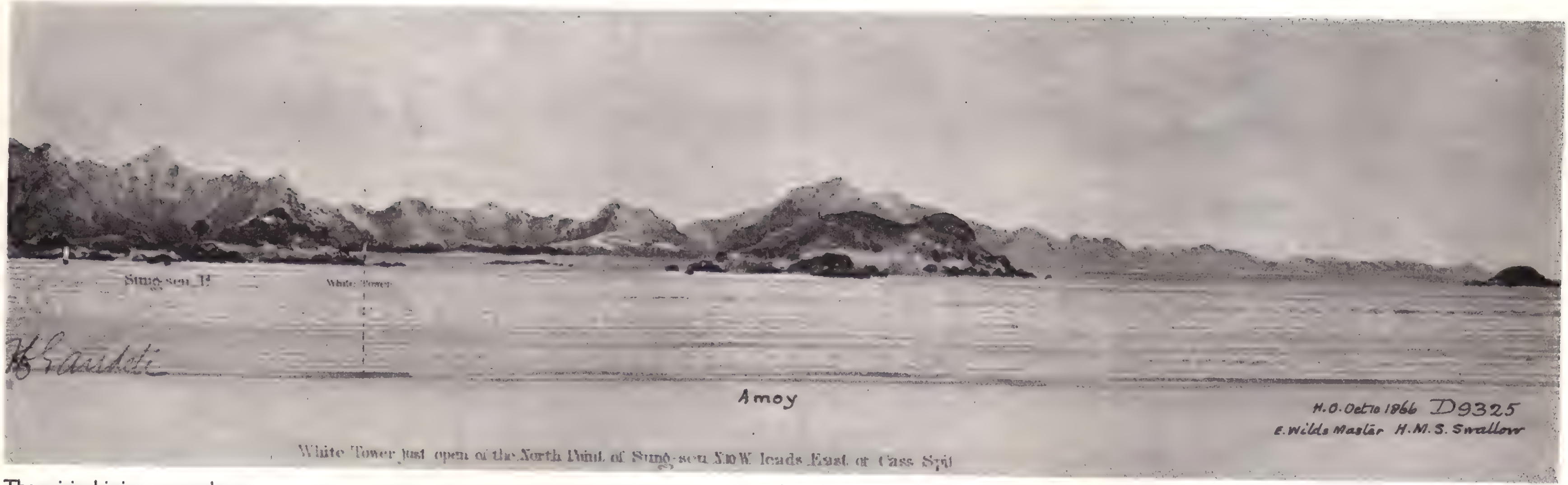
H.M.S. Fairy April 1838

NORTH FORELAND



The original is in water-colour

NANDI HARBOUR


Sung-seu Id
White Tower
Amoy
H.O. Oct 10 1866 D9325
E. Wilds Master H.M.S. Swallow
White Tower just open of the North Point of Sung-seu S10W leads East of Cass Spit

The original is in water-colour

AMOY

X

SURVEY OF LOCH AWE

1861

SCOTLAND

ARGYLLSHIRE

LOCH AWE

SURVEYED BY COMMANDER E.J.BEDFORD. FRGS

Messrs. G.F.McDougall & F.Ray Masters R.N.

and Mr. H.Stafford.

1861

Maol beg { *56°.20′.15″N.*
5.14.52W.

·············· *1* } *fathom lines*
····· ····· *5* }

SOUNDINGS IN FATHOMS

reduced, together with the elevation of the land, to the lowest or datum level of the Loch, which is 14ft 10 below the flag stone at the Inn door at North Port Sonachan

Eiln *Eilean Island* R *Rudha Point* Sgeir *Rock*

g. *gravel* – m. *mud* – s. *sand* – r. *rock* – pt. *peat.*

The mean level of the Loch or 4½ feet *above datum* is 117f 10 above the mean sea level at Bunawe

The greatest velocity of the River is about 8m. pr. hr.

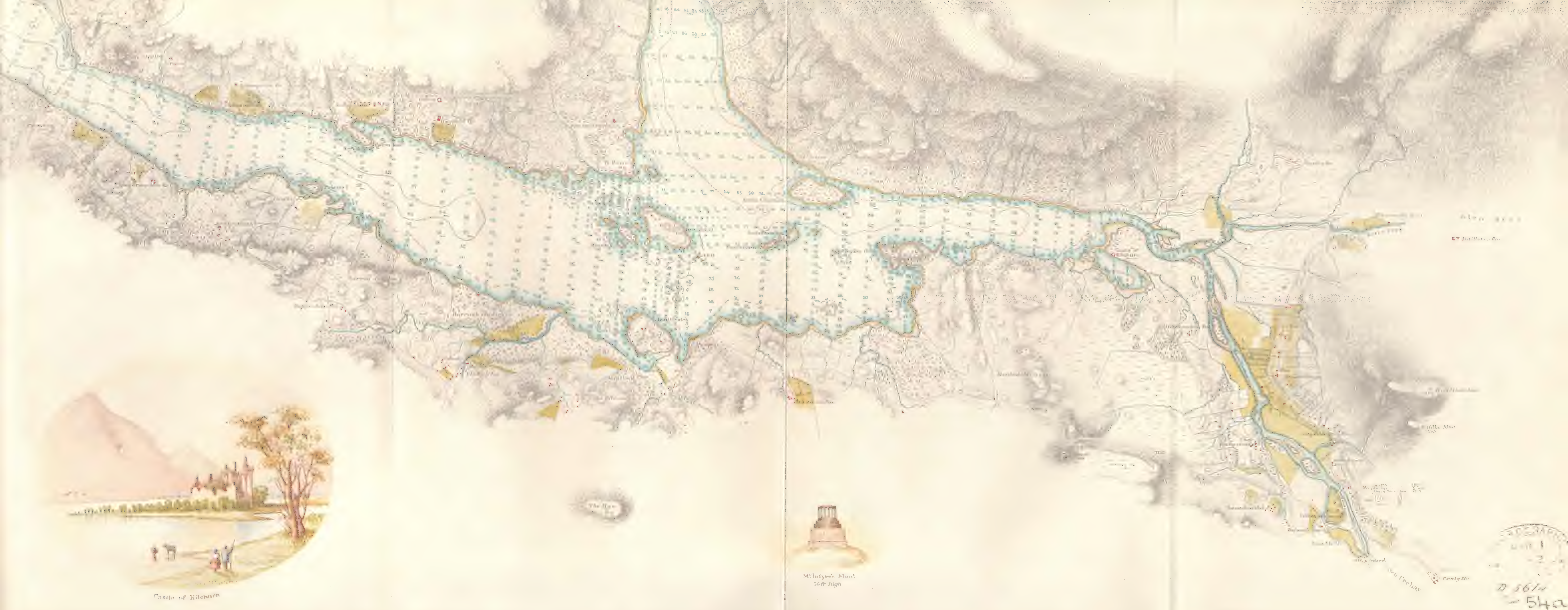
and the density of the water 1000.

One Nautic mile = 6086 ft.

One Statute mile = 5280ft.

Oban Febry 18th 1862

E.J.Bedford



PORTION OF FAIR CHART IN COLOUR *Drawn by Geo. F. McDougall.*

D 5614
54a

During the last two years of his term of office, Hurd completed the arrangements for the sale of charts authorized by the Board minute of November 1819, although permission for its implementation was not given until a year later, when Croker was moved to action by a proposal from Faden offering to undertake the agency. In June 1821, Hurd transmitted a catalogue of all charts, plans, and views that had been engraved, printed, and published in the Hydrographical Office; and he offered various observations in respect of arrangements for disposing of them to the public at a reasonable price. Messrs Faden and Arrowsmith were accepted as general agents, and T. Jones as an agent in Liverpool. In February 1822, Hurd and the chief clerk, Dyer, jointly submitted accounting plans, which were approved and, according to a record in the Issues Division of the department,[1] an initial sum of £72 was received in 1823.

Hurd's salary continued at £500 per annum in addition to half pay, which was, however, allowed only after his representation to Their Lordships that his predecessor had retained an East India Company salary. He held the office of secretary to the Board of Longitude from 1810 to 1819, and for two further years was Superintendent of Chronometers. While Hurd was a commissioner of the Board of Longitude, the Admiralty accepted, in 1818, the administration of the Royal Observatory[2] on a proposal, made two years earlier to the Treasury, that the Board of Ordnance should no longer be concerned. An extract from the minutes of 7 November 1816 containing a Royal Society resolution on the administration reads, '. . . and as the Astronomer Royal ought to be, *and is*, in constant communication with the Hydrographer of the Admiralty, who, with professional members of the Board, are the most proper persons to be consulted . . .'. The President (Sir Joseph Banks) and Council of the Royal Society were confirmed as regular Visitors in 1820, and in the same year Their Lordships agreed in principle to the proposal of the commissioners that an observatory should be established at the Cape of Good Hope. Earlier, in 1816, the Astronomer Royal had been authorized to make regular observations for determining magnetic variation. Hurd, unlike his predecessor and many of his successors, was not elected a Fellow of the Royal Society. He died in May 1823, at which time there were in hand four surveys in home waters and eight abroad under three captains, two commanders, three lieutenants and four masters.

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[1] Appendix C, 5.

[2] It had been in 1675 that Charles II decreed: ' Whereas in order to the finding out of the longitude of places for perfecting navigation and astronomy we have resolved to build a small observatory within our park at Greenwich . . . to a design by Sir Christopher Wren .' The Reverend John Flamsteed, who had proposed lunar methods for longitude, was appointed Observator.

The Royal Society took an active part in the project, and in 1710 Queen Anne appointed the President (Sir Isaac Newton) and nominees of the council of the Society to be ' Visitors and Directors '. After nearly 150 years the administration of the observatory passed in 1965 from the Navy Department to the newly formed Science Research Council.

1823–1829

Parry (W. E.) was appointed on 1 December 1823, some months after Hurd's death, to ' act as Hydrographer of this Office ' despite his nomination for the second Arctic expedition, to be under his command, which left England in May 1824. The country was at peace although pursuing a cause championed by the poet Byron—that of freeing Greece from Turkish oppression, which culminated in the sinking of the Turkish fleet in Navarino Bay in 1827 by Allied fleets.

The Navy was still active in the search for the North-west Passage and, from Parry's days, the department was to be more closely connected with polar exploration and so add to its store of original documents. The activity originated at the end of 1817 with Sir Joseph Banks, who commented to Their Lordships that a voyage in the Arctic region would probably be successful.[1] The Navy Board was directed to select four transports of about 300 tons each to be employed on a voyage of discovery in the Arctic region, and to be ready on 1 March 1818, fitted as usual with Greenland ships; the records show that there were many volunteers for this service. There are original documents in the department's archives from Buchan and Franklin in the *Dorothea* and the *Trent*, John Ross and Parry in the *Alexander* and the *Isabella*, 1818; from Parry in the *Hecla* and the *Griper* 1819, the *Hecla* and the *Fury*, 1821–24, and again in the *Hecla*, 1827; and from the privately organized expedition of John and James Ross to locate the magnetic pole in 1829.

From the Antarctic, there had been the reports of Smith and Bransfield in the South Shetlands, and of Weddell in 1822–24. Deception Island was surveyed by Foster in the *Chanticleer* in 1829, whose cruise, in 1828–31, was proposed by the Board of Longitude in 1826 to determine longitudes, take pendulum measurements, and make other observations connected with nautical astronomy, the instructions for which were drawn up by a Royal Society committee. The extra pay of the commander was shown in the section headed ' Rewards, etc.' in the Navy Estimates for 1832–33. This work was in part a continuation of that done to determine a figure of the Earth by Hall in the *Conway* in 1819 in the Pacific (when Foster, as master's mate, made the first survey of Valparaíso Bay on the Chilean coast) and more extensively in 1821–23 on the equator by the *Pheasant*, and in northern waters by the *Griper* under the scientific direction of Sabine. Astronomer to Ross and Parry in 1818–20, Sabine, as General Sir Edward Sabine, R.A., was President of the Royal Society, 1861–71. Foster's drowning in the Chagres River in 1831 when he was only thirty-six years old provides an example of a surveyor's losing his life in the execution of duty.

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[1] After many years' whaling experience, William Scoresby published that same year a paper on the movements of Arctic pack-ice, in which he demonstrated that a seasonal recession had occurred.

On his return from the Arctic in November 1825, Parry's appointment as Hydrographer was confirmed, but he was absent again in the Arctic from April to October 1827, on his northward journey over the ice from Spitsbergen.

Walker senior, and sometimes Becher, in the absence of Parry communicated with Secretary Croker. The latter's personal authority was now considerable and was to be felt throughout the period, since his secretaryship was to outrun Parry's resignation, except for a brief interlude when the Duke of Clarence was Lord High Admiral and took a personal interest in the department. Croker was concerned to limit the autonomy of the department, and having taken an opportunity to inform Walker in 1824 that 'it was merely a branch of this office', he drew up a minute, dated 18 November 1825, for the 'Regulation of the Hydrographical Branch of the Office'.[1]

The minute commenced: 'The Hydrographical Branch is under the immediate control of the Hydrographer as the other branches are under that of their clerks of the first class, and like them, under the general superintendence of the Chief Clerk of the Office.' It repeated earlier instructions on the use of minutes rather than letters within the Admiralty, but added: 'The Hydrographer may communicate by letter or personally with all officers employed in hydrography and all other persons on subjects particularly connected with his own duties, but whenever any such communication seems of any importance he is to communicate it to the Secretary'—wording similar to that in force at the time of writing. Pecuniary transactions were to pass through the chief clerk; appointments to the branch were to be by Secretary's minute, which also applied to those permitted to complete their surveys in the department. Strict rules for the attendance of the latter were laid down, and their pay, over and above half pay, for every day so employed was given as: captains twenty shillings, commanders fifteen shillings, lieutenants twelve shillings, and midshipmen seven shillings. Concurrently, the recording of minutes in minute-books[2] was begun in the department.

Becher had, in 1823, been the first naval assistant to join the department. It was a temporary assignment, as was shown three years later when Croker accepted his report on the cataloguing and indexing of the original documents, and continued his appointment on a weekly basis. (In fact, except for two brief periods at sea, he served the department for forty-three years and became Chief Naval Assistant in 1862.) Nevertheless, the importance of the documents and the need to amplify the arrangements made in 1819 had been clearly appreciated.

A major development of the Parry period was his institution of 'Sailing Directions' to accompany the charts. It led to the appointment in 1828 of two more naval assistants (making four in all), Rae and Dessiou, on a proposal by Parry, who, however, was enjoined by Croker 'to take care that all despatch is used '. An original title-page of a compilation of 1829 is reproduced opposite, and on p. 38 a title-page of a translation of 1814 of foreign sailing directions, such as were begun in Hurd's day. Parry had previously prepared a ' Notice respecting the establishment of the Hydrographical Office ' on 1 February 1827.[1] This began:

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[1] Appendix C, 4.

[2] Appendix C, 2.

> The slowness with which our hydrographic materials are rendered available by publication arises entirely, I conceive, from the small number of individuals employed in this Department, for it so happens, altho' I believe unintentionally, that almost in proportion as the surveying work has increased (as it has done since the Peace) so has this establishment been diminished; there being three individuals less belonging to it at this time than in the year 1823.

Of the four draughtsmen (the three Walkers and Higgins), Higgins had to help Nares the clerk with chart issues and sales, and Walker senior was engaged on dealing with incoming reports of dangers, which thus left only two draughtsmen on charts for publication. Becher was taking care of the flow of original documents and Remark Books. Parry therefore asked for two more permanent draughtsmen and four temporary until the work was cleared, in addition to a clerk to free Higgins. In a paragraph on Sailing Directions he referred to an earlier proposal in the year to use Remark Books, commenting that it would encourage their senders. He added that surveyors should write Sailing Directions while on their surveys, or else in the department when their memories were fresh, citing Smyth and Owen as current examples. Sailing Directions would, he said, be invaluable to the public and reflect credit on the department.

On 7 June 1827, His Royal Highness the Duke of Clarence, then Lord High Admiral of the United Kingdom and later William IV, the sailor King, directed that six extra draughtsmen should be employed on temporary weekly pay until the clearance of arrears; that weekly reports of their work and a monthly report from the engravers should be made to His Royal Highness; that Becher should compile Sailing Directions for publication; and that a clerk should be added for chart supplies. It was in this year that Sheringham joined as a naval assistant, probably in lieu of the second clerk proposed; and that Walker and Becher were given extra room for the documents.

Both Parry and His Royal Highness referred also to the use of lithography—a popular new means of reproduction patented in England in 1801. In an earlier minute to the Hydrographer and others, Croker had stressed its merits as, ' though not so neat as engraving, its cheapness, celerity, and ease of working, particularly for maritime charts not so crowded as geographical maps '. He ended: ' We have an excellent litho-press and I shall expect to find it constantly in use .' Parry, questioning the comparative advantages, referred to the problem of correcting stones and to their preservation from

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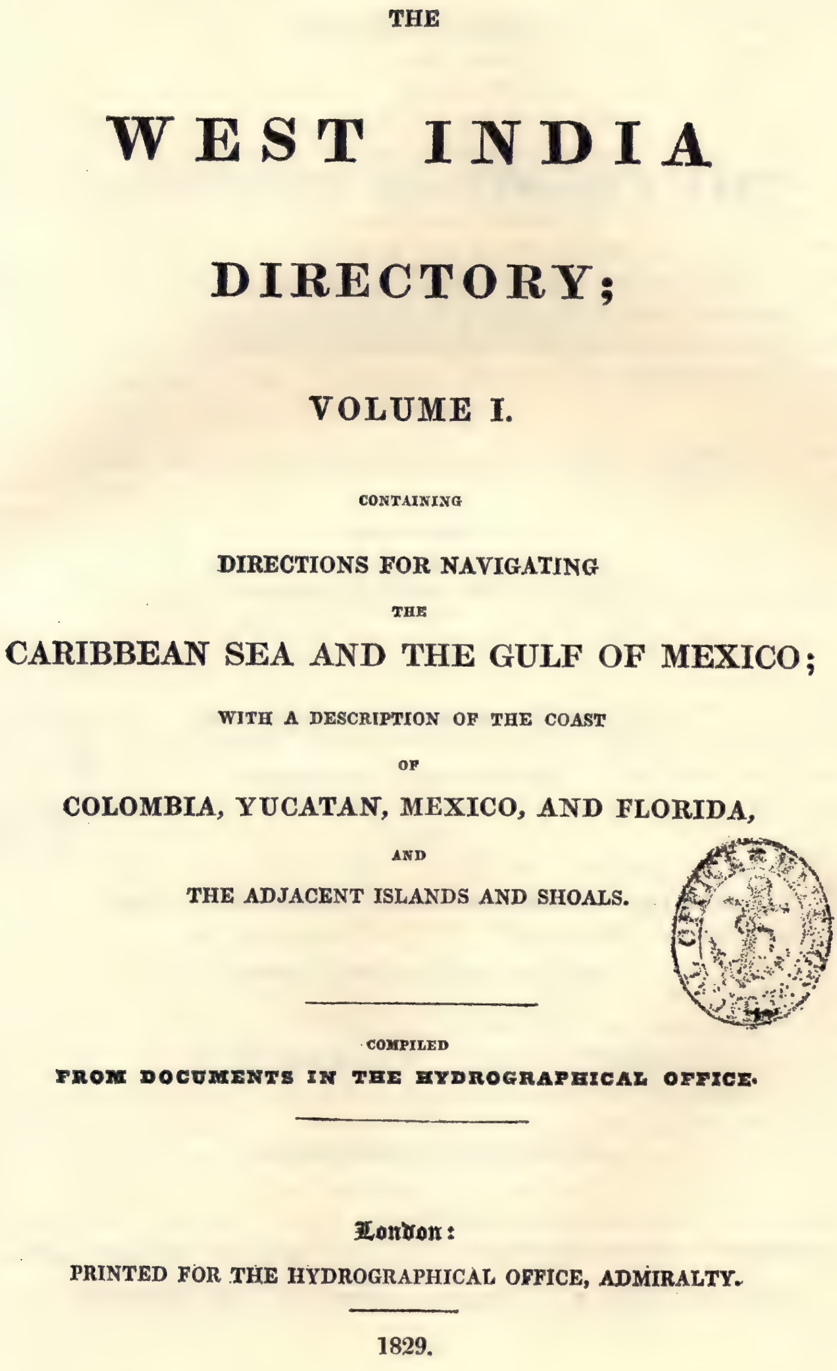
[1] Appendix C, 4.



THE

WEST INDIA DIRECTORY;

VOLUME I.

CONTAINING

DIRECTIONS FOR NAVIGATING

THE

CARIBBEAN SEA AND THE GULF OF MEXICO;

WITH A DESCRIPTION OF THE COAST

OF

COLOMBIA, YUCATAN, MEXICO, AND FLORIDA,

AND

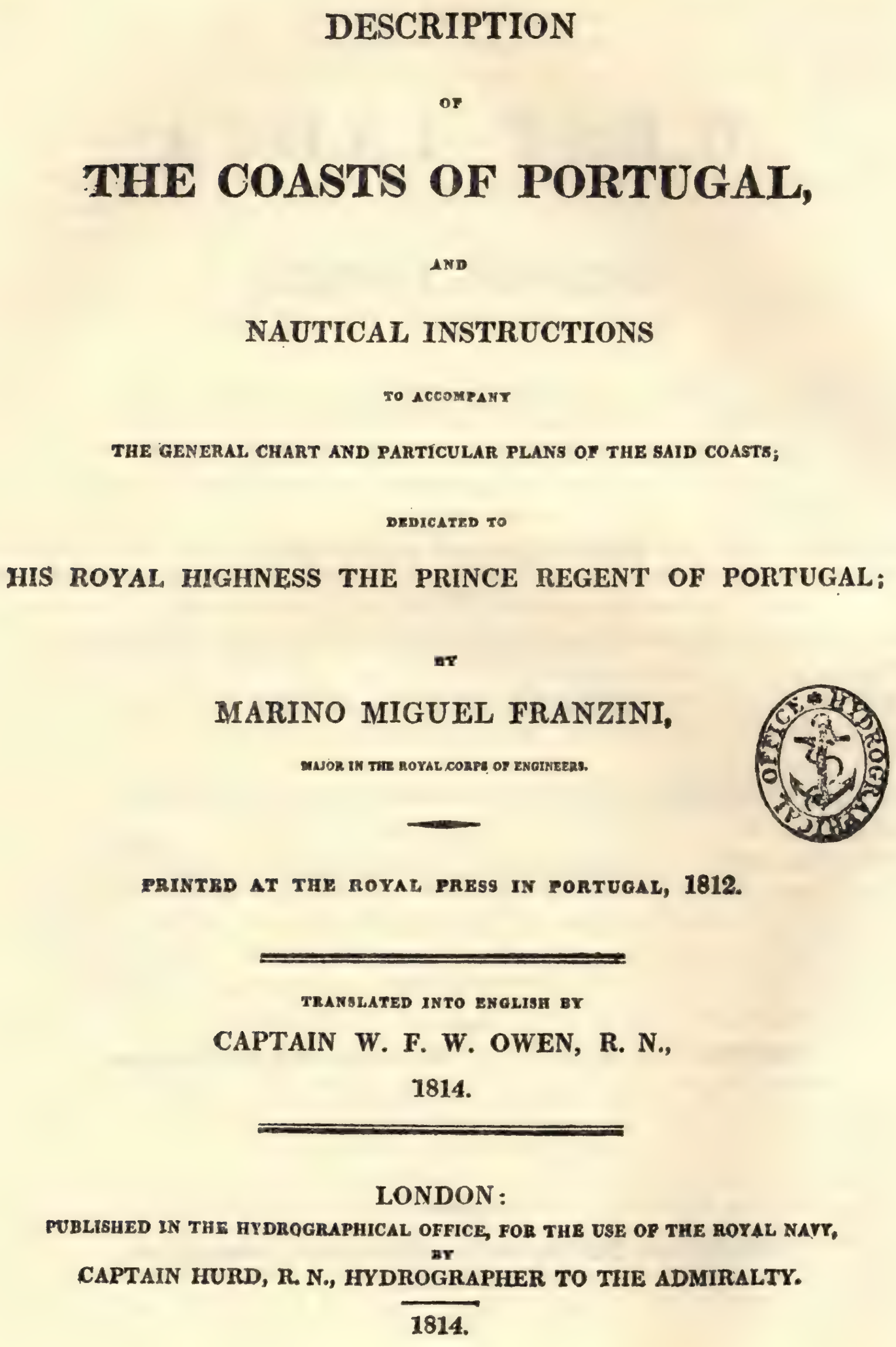
THE ADJACENT ISLANDS AND SHOALS.

COMPILED

FROM DOCUMENTS IN THE HYDROGRAPHICAL OFFICE.

London:
PRINTED FOR THE HYDROGRAPHICAL OFFICE, ADMIRALTY.

1829.



DESCRIPTION

OF

THE COASTS OF PORTUGAL,

AND

NAUTICAL INSTRUCTIONS

TO ACCOMPANY

THE GENERAL CHART AND PARTICULAR PLANS OF THE SAID COASTS;

DEDICATED TO

HIS ROYAL HIGHNESS THE PRINCE REGENT OF PORTUGAL;

BY

MARINO MIGUEL FRANZINI,

MAJOR IN THE ROYAL CORPS OF ENGINEERS.

PRINTED AT THE ROYAL PRESS IN PORTUGAL, 1812.

TRANSLATED INTO ENGLISH BY

CAPTAIN W. F. W. OWEN, R. N.,

1814.

LONDON:
PUBLISHED IN THE HYDROGRAPHICAL OFFICE, FOR THE USE OF THE ROYAL NAVY,
BY
CAPTAIN HURD, R. N., HYDROGRAPHER TO THE ADMIRALTY.

1814.

injury, and therefore considered that it was too early to accept lithography. Concurrently, Owen had complained of delays in the publication of his charts of Africa owing to their being reserved by the Secretary for an experiment in the new process. His Royal Highness's ruling was that lithography should be used for less-important work only.

The scales of surveys also received comment in both documents. Parry proposed that to prevent delay, every Admiralty surveyor should send in his work in a form suitable for immediate engraving and publication. He accepted, however, that the scale of the survey must be at the surveyor's discretion. His Royal Highness's memorandum said that a circular should be sent to surveyors on the subject, ' using discretion as to scale omitting nothing of consequence but not making the drawing too voluminous or cumbersome '. The circular was sent out on 28 June 1828[1] to all officers who may be employed in making surveys. It laid down

> the following scales according to the nature of the Coast, Harbour, etc., without regard to uniformity in the size of paper: General Charts 1½ inches to one degree of longitude; Portions of Coast ¼ inch or ½ inch to a nautical mile; Particular plans 1½ inches or 3 inches to a nautical mile. . . . You will in future transmit the rough charts also, showing the whole of the triangulation, and giving so explicit an account of your mode of proceeding and of determining the several bases, as may enable His Royal Highness to judge of the degree of confidence that may be placed in the accuracy of your several surveys.

Besides the Sailing Directions, 'Light Lists' were also initiated in this period. A description of the lighthouses on the coast of the United States of America was received in 1827, whereupon Croker directed: ' Let them be printed for use in the Hydrographical Office and one copy be put in the appropriate chart-box.'

The first chart catalogue,[2] based on Hurd's preparations in 1821, was published in 1825. Its title-page is reproduced overleaf. J. King of Bristol was added to the list of agents in 1827. Charts were on sale and return, the agency fee being twenty-five per cent.

Charts were listed by their title, by whom surveyed, but undated, and by their price. There were 643 charts or surveys and 98 views, many being of foreign origin. Forty-five of them were indicated as having been compiled in the Hydrographic Office. Charts in each of the eighteen geographical sections were sold in stiff, marbled covers, or separately. Charts of the west coast of the United Kingdom were conspicuously absent, there being no chart north of Liverpool Harbour. The catalogue was printed by G. Hayden, printer to the Admiralty Office. Charts were printed in the Admiralty as is shown by a note from Parry to Becher in March 1827: ' No copper plates are ever to be taken out for printing but the whole to be done upstairs.'

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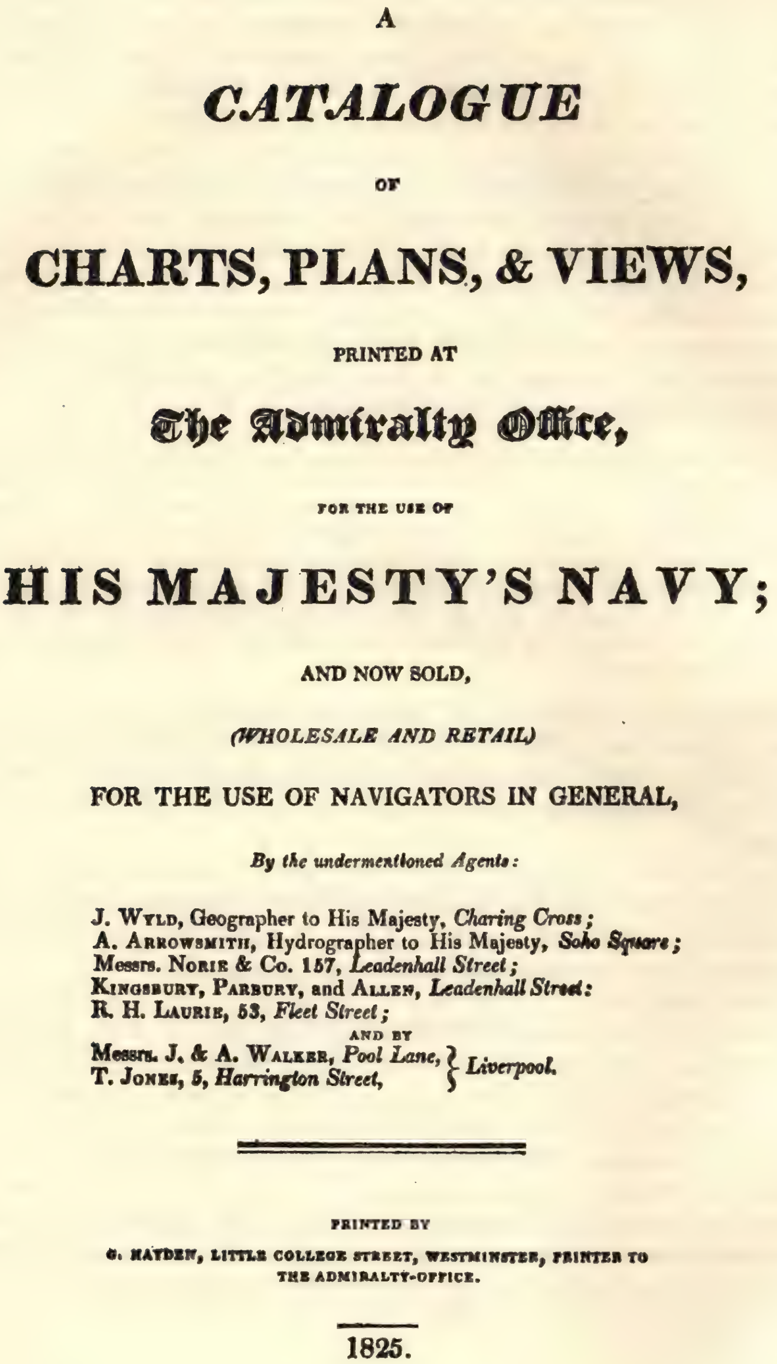
[1] Bibliography 1, 5.

[2] Bibliography 2, 1.



A
CATALOGUE
OF
CHARTS, PLANS, & VIEWS,
PRINTED AT
The Admiralty Office,
FOR THE USE OF
HIS MAJESTY'S NAVY;
AND NOW SOLD,
(WHOLESALE AND RETAIL)
FOR THE USE OF NAVIGATORS IN GENERAL,

By the undermentioned Agents:

J. WYLD, Geographer to His Majesty, *Charing Cross;*
A. ARROWSMITH, Hydrographer to His Majesty, *Soho Square;*
Messrs. NORIE & Co. 157, *Leadenhall Street;*
KINGSBURY, PARBURY, and ALLEN, *Leadenhall Street:*
R. H. LAURIE, 53, *Fleet Street;*
AND BY
Messrs. J. & A. WALKER, *Pool Lane,* } *Liverpool.*
T. JONES, 5, *Harrington Street,* }

PRINTED BY
G. HAYDEN, LITTLE COLLEGE STREET, WESTMINSTER, PRINTER TO
THE ADMIRALTY-OFFICE.

1825.

An old copy of Chart 165, 'General Chart of the Hydrographical Situation of Sicily from the surveys and examinations of Captain Smyth', was inscribed: 'London. Published according to Act of Parliament at the Hydrographical Office of the Admiralty 19th July 1823.' It showed that the oval of the seal had been decorated with oak-leaves, a rose, and a thistle. It made use of the 'no-bottom' symbol, and showed where overfalls might be expected in the vicinity of Adventure Bank. There were many coastal names of places but no topography.

Smyth's work in the Mediterranean is also shown on old copies of Charts 242 and 243 of the coast of Egypt and Alexandria from surveys in 1822, though the former was not published until 1834. They will have replaced the charts of 1801[1], and Chart 242 is of interest in that it carried the first example to be seen of a note: 'Navigators are recommended to keep outside the ten-fathom line.'

Chart 636, published in 1828, is an example of W. F. Owen's African surveys and, as remarked,[1] is the first Admiralty chart to be found of the Cape of Good Hope. An ungraduated plan 18 by 24 inches (m = 0·48 inch), it was engraved in considerable detail by J. and C. Walker. The survey was done by Lieutenant A. T. E. Vidal of H.M.S. *Leven*, assisted by Captain Chas Lechmere, R.N., Lieutenant T. Boteler, and Mr H. A. Gibbons, Admiralty midshipman under the direction of Captain W. F. W. Owen, 1822. Additions were made by Mr Brown, master of H.M.S. *Andromache*. The chart carried a table of heights of prominent features, and the longitude of the Cape was given as 18° 24·4′ E compared with 18° 23¼′ of Lieutenant Rice in 1797.[1]

Supplies to the Fleet grew to 464 boxes in 1828, the year in which Sheringham proposed canvas covers, the boxes to become packing-cases for folios of charts in transit. The first overseas chart depot for the supply of H.M. ships was established at Gibraltar in 1827 with half a dozen sets of Mediterranean charts. Charts had been sold to the value of £72 in 1823 and £383 in 1828.[2]

A sole agent for charts was proposed by Sheringham in a lengthy report to Parry dated 12 January 1829. One paragraph read:

> I am persuaded at this moment the desire of the Trade to become the Agents for the sale of Admiralty publications, does not arise from any emolument that they expect such sale will produce them; but relates more immediately to the flagitious intention of transferring such portions of our new matter as may be introduced into their own publications.

He described two consequent evils, one being their presentation of garbled extracts through bad compilation of their publications; the other, the pecuniary benefit that they derived from new information, which ought rightly to accrue to the public purse. The same source shows that Parry consulted the Ordnance Map Office about their procedure before making official proposals. These were eventually countersigned by his successor, Beaufort, on 8 July 1829, and he was directed by the Secretary to take the necessary measures. The conditions were that the agent was to be suitably resident and to give adequate security; that charts were to be for sale and not return; that a set for demonstration should not be supplied; that the agent should appoint his own subagents; and that discount was to be forty per cent on all charts delivered by the office. R. B. Bate agreed these terms on 31 January 1829 and in the following year a notice was promulgated and printed in *The Navy List*. It announced:

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[1] See p. 21.

[2] Appendix C, 5.

> The Lords Commissioners of the Admiralty, being desirous to extend the benefit of marine surveys which have been made for the use of H.M. Navy more generally among the Mercantile Shipping of the Empire, have appointed Mr R. B. Bate, 21 Poultry, London to be Their Lordships' agent for the sale of all charts etc. published under Their Lordships' orders . . . all corrections will be notified to the agent so that latest information may be available. . . .

The latter statement shows the beginning of the important arrangement whereby charted information is kept up to date, the need for which having been exemplified in 1827 when an error was reported in a chart of Guernsey, which had been published in 1817 and which had not been replaced by a new chart of 1822. The development of methods to ensure that published navigational information is continuously kept up to date has indeed never ceased to be a major concern of the Hydrographic Department.

One more important development of this period was the beginning of interchange arrangements with other hydrographic offices,[1] the first apparently being made in 1822 with the Hydrographic Office of Copenhagen, according to a letter from Captain Schifte of the Danish Navy in 1826. Sweden followed in 1828, and that same year a communication through the Foreign Office to embassies and consulates aimed at establishing relations with the French, Spanish, Russian, and Neapolitan offices. Close cooperation, which included the exchange of documents, was maintained with the Ordnance Survey and the East India Office, where Horsburgh had succeeded Dalrymple and by 1810 had completed his renowned *East India Directory*. The British Museum was regularly supplied with copies of Admiralty charts as they were published.

As for expenses, the system of monthly imprests ceases in the records from 1823, but Parry[2] gave a breakdown of the 1826 expenditure as follows:

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[1] Foreign hydrographic offices (with the years of their foundation) were France (1720), Denmark (1784), Spain (1800), U.S. Coast and Geodetic (1816), Russia (1827), U.S. Hydrographic Office (1830) (from *International Hydrographic Bureau Year-Book*). Results of surveys in foreign waters were, however, received before the establishment of such offices—e.g., Russian surveys dating back to 1807.

[2] Appendix C, 4.

engraving £637; printing, mounting, cataloguing £381; purchase of charts £262; wages £847; instrument repairs £20; petty disbursements £58—total £2 205. Other details were: Walker's increment £100; optician's bill for instruments, including those for discovery ships, e.g. Franklin's, £1 125; drawing-paper from H.M.S.O. £536; stationery £45. For the year 1827, Parry mentioned Mayne, Mudge, Bullock, Harris, and Denham as having drawn charts in the office. Owen and Smyth had done so in previous years, Smyth's attendance being peremptorily terminated by Croker on 14 October 1826 with instructions that the following week was to be spent by him in giving directions to facilitate the completion of the engraving of his charts. On 30 December 1828, Parry reported in detail on departmental expenses, commenting on the improved arrangements and the work of the temporary draughtsmen. He indicated that the number of charts in publication on 1 January had increased from 575 in 1821 to 986 in 1829, so that the production of charts cost £600 more, even after allowing for receipts from sales. The number of surveys in hand (twelve) in 1828 was more than ever before. These facts explained ' why expenses had outgrown the original estimates and the certainty they must continue to exceed it '. Navy Estimates[1] from 1810 to 1830 show under civil, and later public, departments that the allowance for the Hydrographer's contingencies rose from £150 to £4 000, and that his salary was £500 per annum. Following a complaint of a defective supply from T. Jones, optician, in 1827, instruments supplies were taken over by the Hydrographer, who had been responsible for chronometers from 1809.

Two minor matters recorded during the period are of passing interest, as both reappear in later years. In 1824 a Mr Stackhouse proposed a new water-resisting and more durable paper for charts; however, after several years' trial it was not adopted. A Captain Bradley had, in 1823, offered a suggestion with a view to remedying the want of colour on charts, but the reply according to the Admiralty digest was: ' Their Lordships will give him no further trouble.'

In surveying, there was close collaboration and cooperation with the Ordnance Survey in the extension of their triangulation; and, a forerunner of later arrangements, a proposal was made that if their surveys were forwarded to the office, naval surveyors would be directed to put in such parts of the coastline as might be required for nautical purposes. Instructions continued to be drafted by the Hydrographer for forwarding by the Secretary. The time-honoured words appear: ' So soon as *Investigator* is ready for sea . . . .' At the close of the Parry period there were fourteen surveys in progress in charge of two captains, seven commanders, four lieutenants and one master. In four cases, one in Canada and three in home waters, hired vessels or boats were used to economize in naval manpower. Foreign surveys were in South America by King and Fitzroy in the *Adventure* and the *Beagle*, in West Africa by Boteler in the *Hecla*, and in the Mediterranean by Copeland in the *Mastiff*. The state of major British surveys at this time is shown on Plate XI.

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[1] Bibliography 1, 3.

Parry resigned in 1829, when less than forty years of age, from an office that evidently could not contain one so active in mind and body.[1] He had been knighted earlier that year, and was a Fellow of the Royal Societies of London and Edinburgh.

1829–1855

Beaufort was appointed to succeed Parry as Hydrographer on 14 May 1829. During his twenty-five years of active sea service, he gained his surveying experience in the river Plate and on his extensive survey of the coast of Karamania in 1811–12, when he was severely wounded for the second time in his career. In the ensuing years he had prepared this and other work for engraving and publication as Admiralty charts. He served as Hydrographer with great distinction for twenty-six years, a period of change and progress in the reigns of William IV and Victoria; a period of *Pax Britannica*, which, from 1815 to 1900, encouraged the freedom of the seas to all using British naval supremacy as the instrument, and which also included the availability of Admiralty charts to mariners of all nations.

Europe was at peace until 1854 when the Crimean war broke out. In the associated naval operations, Brock served with the Commander-in-Chief, Mediterranean, Sulivan and Otter playing a part in the Baltic. There had earlier been the first Chinese war of 1839–42, when Captain Elliot, R.N., Chief Superintendent of British trade in China, fell back under Chinese pressure to the island of Hong Kong, formally ceded to Britain in 1841, when the five treaty ports—Canton, Amoy, Foochow, Ningpo, and Shanghai—were opened to European trade. There and in the Yangtze, Collinson, Belcher, and Kellett were involved. On the other side of the East Indian scene, Aden was added to the Crown in 1839, becoming an important coaling-station. Surveying ships of the East India Company, or Indian Navy from 1830, had, however, been working in the Red Sea and Persian Gulf since 1804, which included a period from 1823 to 1833 under the distinguished superintendence of Daniel Ross. Naval activity against pirates in the South China Sea was also in progress while 'Rajah' Brooke was establishing the British position in Borneo and Sarawak; here Belcher was an active participant. Elsewhere, the Navy was still engaged in putting down the slave-trade, although there is record that Denham, *en route* to the Pacific, was told in 1852 that the Board of Admiralty did not allow him to act since he was on a peaceful mission.

At home, in 1830, Stephenson's steam locomotive was used on the first important railway—between Liverpool and Manchester. Others followed rapidly. Concurrently, McAdam introduced improvements to road surfaces. Considerable work fell on the Hydrographic Department, which initially assumed the role of safeguarding harbour navigation from hindrance by transport systems, bridges, and so on. Steam had been used in small vessels from the beginning of the century, and by 1820 there were harbour craft on the Clyde and the Thames and in naval ports. Ocean-going ships, both naval and mercantile, using steam as their main source of propulsion were in service in the 1830's, the *Sirius* and the *Great Western* commencing a regular Atlantic service in 1838. The year 1836 saw the replacement of paddle-wheels by the screw propeller, which, in 1843, was fitted to H.M.S. *Rattler* and S.S. *Great Britain*. The first use of steam in surveying seems to have been in 1828 by R. Owen (nephew of W. F. Owen) in the *African* on the Gambia. In 1832, Denham hired a steam vessel for his work in the Bristol Channel. From about 1830, iron was used in ship construction, the successful S.S. *Persia* coming in 1855, and the iron-built, armour-clad H.M.S. *Warrior* in 1860. Increased speeds and the use of iron brought the need for better compasses and methods for their correction, and again the department was involved, as will be discussed.

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[1] The biography by Ann Parry, *Parry of the Arctic*, Chatto and Windus, 1963, tells how Parry was back at the Admiralty as Comptroller of Steam Machinery from 1837–47.

A new London Bridge was completed in 1831 to replace the famous Old London Bridge which had stood for six centuries and was said to have contributed to the several major freezings of the Thames by greatly restricting the river's flow. There had been a bridge in Roman and Saxon times; and to the bridges at Westminster and Blackfriars, built in the second half of the eighteenth century, were now added Southwark Bridge and Waterloo Bridge.

Activity in geophysical as well as geographical exploration was considerable, and Beaufort was at pains to foster a close association with it by the department at the Admiralty and by the surveyors afloat. But Beaufort, like his predecessors, had to accept an occasional lack of appreciation by the Board—in 1847 and 1853 there were severe cuts in the surveying service, and additions to departmental staff were hard to come by.

Finally, this background cannot conclude without mention of Beaufort's long-lasting responsibility and anxiety in the search for the Franklin expedition, the fate of which was in doubt a year after it had sailed with the *Erebus* and the *Terror* in 1845. The searches involved James Ross in the *Enterprise* and the *Investigator* in 1848, Belcher and Kellett in the *Herald*, *Plover*, and *Resolute* in 1852–54, and others in intervening years. Meanwhile, McClure in the *Investigator* had, in 1850, sailed through Bering Strait to Port Mercy in Banks Land, opposite Parry's farthest on Melville Island in 1819. Accordingly, when Field in April 1906 answered a question on the North-west Passage, he said that McClure had achieved the reward although he had to abandon his ship before continuing to the Atlantic. He added that the *Erebus* and *Terror* in 1846–47 did what Parry had done in 1819, and any claim by ships from the westward must be on behalf of Parry rather than Franklin. In the

Antarctic, there were the voyages of the sealers in 1832–33, including the discovery of Graham Land, and of James Ross in the *Erebus* and *Terror* with scientific objectives in 1840–43.

For sources of information during the period there is an immense amount of material in the Hydrographic Department's records, as Beaufort encouraged and maintained a heavy correspondence with his surveying commanders afloat, and, indeed, in all fields of his activity as Hydrographer. Navy Estimates became more detailed from 1831. The *Nautical Magazine* appeared in 1832, and the Admiralty *Manual of Scientific Enquiry* in 1849, both these publications owing much to Beaufort's support. The Geographical Society's[1] journal contained an account of Admiralty surveys, included in the annual presidential address and in some detail from 1844 onwards. The chart catalogues continued to appear regularly, and 'Admiralty Surveys' started in 1851.[2]

One of Beaufort's often-quoted dictums is: The natural tendency of men is to undervalue what they do not understand.[3] It was originally said at a meeting of the Royal Society, according to Dawson's *Memoirs of Hydrography*, Part II, but the occasion cannot be traced, nor can the context, which presumably referred to one or other of the economies in departmental expenditure during the period under discussion.

At the Admiralty, concurrently with the Reform Bill of 1832, after which naval members of the Board no longer had seats in the House of Commons, there was a reorganization by an Act that transferred to the Board the two subsidiary commissions, the Navy Board and the Victualling Board, and created in lieu five Admiralty officials—the Surveyor or Controller, the Accountant-General, the Storekeeper-General, the Comptroller of Victualling, and the Physician of the Navy.

In the previous year a scientific branch had been instituted, which comprised the Hydrographic Department, the Royal and Cape Observatories, the Nautical Almanac Office, and the Chronometer Office. Its Estimates, largely prepared by the Hydrographer, allowed for expenditure on scientific expeditions and 'rewards' for special services or inventions, such as: '1834, the officer exploring the Quorra £119, ditto the Southern Continent newly discovered £119.' For the Hydrographical Branch in 1831 details of the Estimates are given in Bibliography 1, 3.

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[1] The idea of the society was conceived in the Raleigh Travellers' Club, formed in 1826. Its small membership included Parry, Beaufort, Beechey, and Smyth as well as Barrow, Second Secretary of the Admiralty and a constant supporter of geographical science. In 1830 a group of six, including Smyth, who had also sketched out a scheme, met in Barrow's room at the Admiralty—Barrow being the senior member—and on 16 July they constituted the Geographical Society of London, which from the start had the royal patronage of William IV. Barrow and Franklin were among the vice-presidents, and Beaufort, Smyth, and Horsburgh were on the council. The original membership of 460 included many distinguished surveying officers.

[2] For a brief account of Beaufort's personal contribution there is the Centenary Lecture by the Hydrographer of the Navy in 1958 published in Volume XI, No. 3, of the *Journal of the Institute of Navigation*—a body formed in 1947.

[3] See p. 13.

Twenty-four years later (one draughtsman was added to make five in 1837), the assistants and draughtsmen had not risen to more than six of each—the former including one tide computer—and there is doubt whether the establishment was always complete. The provision for purchasing, engraving, printing, and so on, of charts had become £4 000, and the total office expenditure £26 000. From 1850 there are Estimates for the surveying service that included expenses under other Votes, such as pay, victualling, stores, and the like. In 1855 this cost was £60 000, though it had reached £69 000 in 1853.

Becher continued as the senior naval assistant except in the years 1839 and 1847 when he was on surveys in home waters. John Walker died on 26 July 1831, and was succeeded as Assistant Hydrographer by Michael Walker, who was replaced by Tucker. A return in 1830 shows only Becher, Barnett, and Dessiou as naval assistants, the three Walkers and Higgins as draughtsmen, and Anderson and Nye as packers. Miles was soon to join and be a valuable naval assistant for nearly twenty years, dying in harness. Dunsterville entered as a naval assistant in April 1842 and remained as such for twenty-eight years. A detailed record of the naval assistants' duties in 1849 shows that Becher retained the responsibility for the original documents and the issue of chronometers; Miles handled the correspondence, accounts, estimates, Remark Books, surveying instruments, the issue of barometers and *The Nautical Almanac* to H.M. ships; Dunsterville inserted in Admiralty and publishers' charts all the additions and corrections since publication, one correction frequently affecting up to 200 copies. Dunsterville, moreover, dealt with issues and sales, keeping up the supply of chart-boxes at naval ports at home and abroad, and he also advised on pilotage questions. Burdwood compiled Sailing Directions, including the use of Remark Books, and was in charge of 'master's qualifications'. Lastly, Mr D. Ross discussed tidal observations, deduced establishments of ports and formed 'Tide Tables' from them. This issue of Tide Tables, stemming from a request by the Royal Society in December 1833, to which Their Lordships then said they were only prepared to collect and print, and must decline calculations, was in fact the principal addition to the department's publications during the Beaufort period. The title 'Tide Computer' first appeared in the Estimates for 1849–50. In 1854 Beaufort reported the death of Ross, then an unfortunate cripple without the use of his limbs, as a severe loss, and he strongly recommended Burdwood as his successor with an increased annual stipend of £200. By 1858 the Tide Tables contained predictions for twenty-three home ports and one colonial port; and some historical information can be found in the *Admiralty Manual of Tides*, H.M.S.O., 1941.

In 1846, according to a memorial asking that they be 'established', the draughtsmen then under the supervision of M. Walker were Higgins, T. Walker, Purdey, Berningham, and Horsfield. Accommodation evidently continued to be extremely limited—a memorandum of Beaufort's in 1841 ran: 'Whenever a box of charts is to be made up a notice is to be given in the four rooms of the department and during the following two hours neither Anderson nor Nye are to answer a bell, quit that employment or attend to any order from any person unless under some peculiar circumstances, such as a Board Order which must pass through.' The fact that packing had to be done in the corridors is further evidence. The title Chart Branch first appeared in the Navy Estimates for 1854–55, being officially recognized by the Order in Council of 19 July 1862. It embraced the naval assistants, the draughtsmen, the packers, and the porters (later messengers), and has continued to the present day. Details of how the draughtsmen under J. and, later, M. Walker compiled chart drawings for the engraver are not found in the records. Their work was done under the close supervision of Beaufort; according to Richards in his *Memoir* of 1868,

> no chart or other document was ever permitted to be made public until it had undergone his personal revision and critical examination; he carried this almost to a fault; and the consequence was that he left a vast mass of material behind him, the publication of which had not kept pace with its collection. It must be remembered, however, that in the early days of his official life, and for some time after them, this personal supervision was positively necessary; and it is very difficult to depart from habits of this character once acquired.

There is some support for this comment in the evidence Washington gave in 1855 to a committee of inquiry[1] in which he said, '. . . to show the enormous increase, there were in 1830 nineteen new charts, 1832 fifteen, 1834 fourteen, 1836 twenty and 1855 one hundred and thirty, chiefly from our home and foreign surveys'. Elsewhere, the number in 1848 is given as seventy-nine. Beaufort's shortages in drawing staff has, however, to be remembered. By inference from the first edition of *General Instructions for Hydrographic Surveyors* about 1850, which referred to manuscript instructions in a similar form over the previous twenty years, the draughtsmen became increasingly concerned with the conversion of the surveyors' originals into chart drawings for the engraver. The scale of the survey was to be such as to show all the minutiae, whereas the scale of the resultant chart depended on circumstances of which the surveyor was no competent judge. Moreover, tracings of completed parts of a survey were to be held ready for dispatch whenever there was an opportunity to send them home. Soundings were rated next in importance to the accuracy of the coastline, though their precision and fullness received comment. The draughtsmen must also have been engaged to some extent on charts published from foreign sources, even though foreign originals from Dalrymple's days were sent to the engravers for copying. Indeed,

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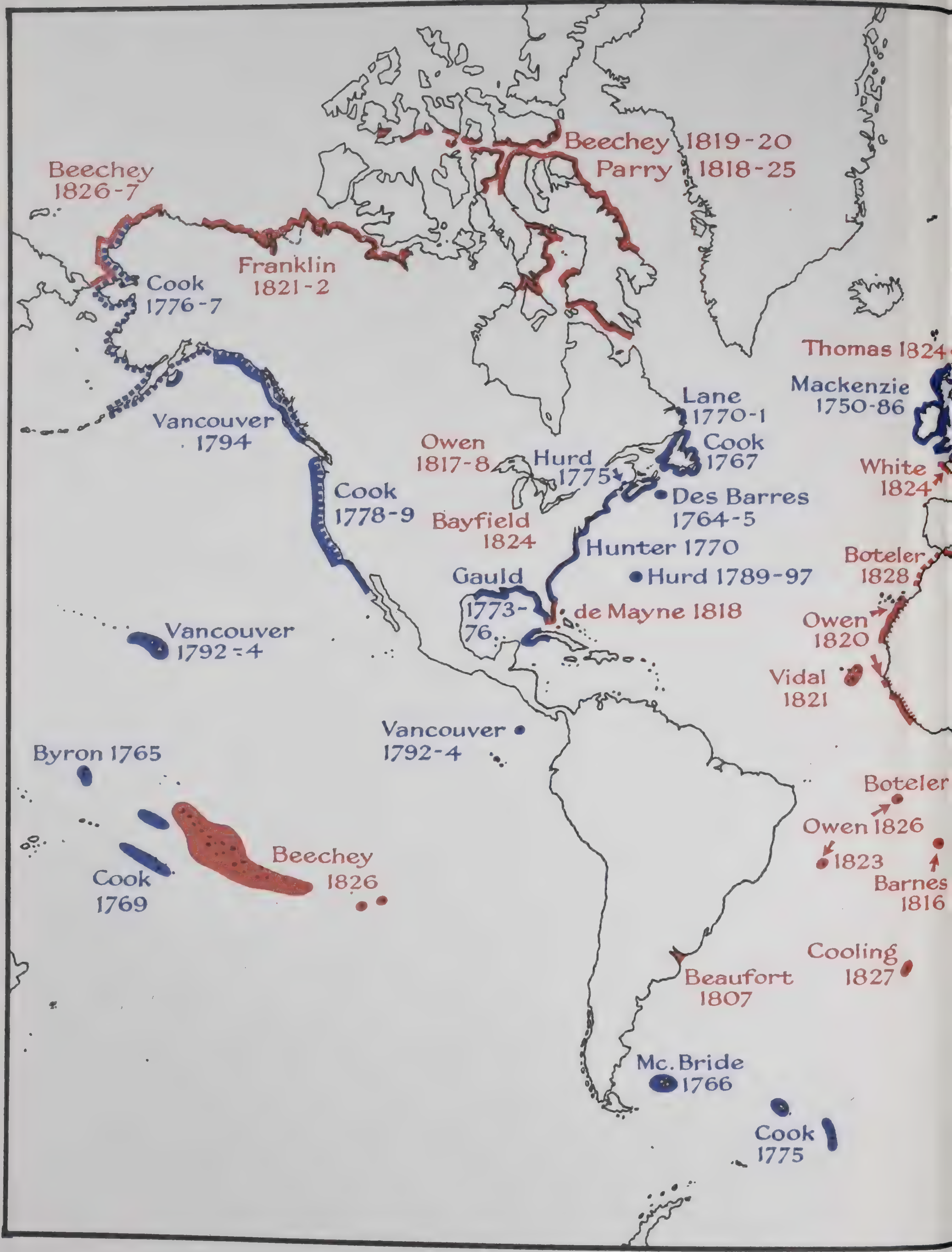
[1] Appendix C, 4(*b*) (Misc. 12).

XI

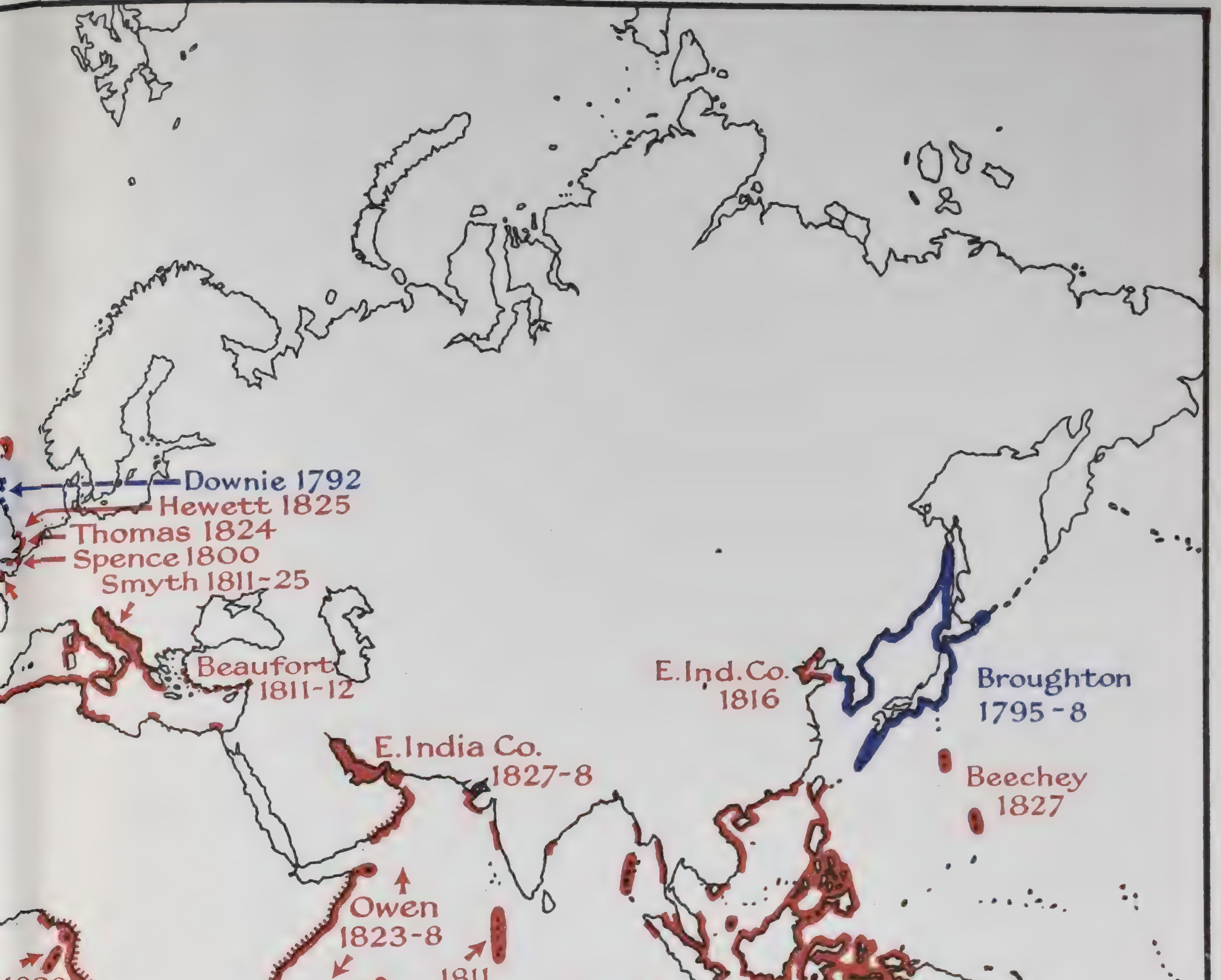
THE WORLD

Showing British surveys up to 1829



PRINCIPAL BRITISH HYDRO

BEFORE 1800



GRAPHIC SURVEYS TO 1829

AFTER 1800 ——— ········ ———

according to the catalogues, the total number of Admiralty charts published rose from 852 in 1830 to 1 981 in 1855.

The policy, fostered by Parry, of sharing hydrographic information among the maritime nations was further encouraged by Beaufort. The Americans were cooperative and the French Hydrographer hoped in 1848 that France's becoming a republic would not upset arrangements. A copy of the first number of the *Nautical Magazine* was sent to the Russian Hydrographer in 1832, and the effectiveness of the exchanges with that country is illustrated by the number of Admiralty charts later prepared from Russian surveys and by Admiral Ommaney's congratulating Beaufort on the White Sea charts during the naval operations of 1854. In 1850, however, Beaufort had to record that the Russians were coldly receiving information sent them in accordance with the policy.

Some information on cartographic developments during the period has again been obtained from a study of a selection of old copies of published charts. Those prepared from British surveys have been used. The dates of changes are only an approximate guide to the year of their introduction. The seal carried the Hydrographer's initials (F. B.) in 1830. The inscription continued to run, ' Published according to Act of Parliament at the Hydrographical [Hydrographic from 1839] Office of the Admiralty ', sometimes preceded by ' London '; the date followed. J. and C. Walker were the engravers (shown as ' Sculpt.') prior to 1853. Titles thenceforth became progressively less flowery and more informative. In 1830 a datum of L.W. springs was given, and in 1846 a local datum-mark with its height above L.W.L. was quoted. H.W.F. and C. details with tidal rises and ranges were given in 1830, a nd ebb and flood arrows in 1839. Chart 103, ' Lowestoft Roads ' by Hewett, August 20, 1836, named the ship *Fairy*, showed buoys as black open-ended cones, and a floating light-vessel in elevation; it also quoted a geographical position. In 1839 there was the use of underlined figures on banks to express depths at H.W., which became H.W. springs about 1850 when heights on land were given above that datum.

For the scales on plans, the term nautic mile became sea mile about 1844 when a second term of fathoms was shown, soon to become cables. The graduation became more closely subdivided. Compasses were true roses having a magnetic-north arrowhead. Much attention was given to qualities of the bottom. Views and sketches of objects were being given in 1839, and magnetic bearings of leading lines, anchorage marks, and so on, in 1853. There was an inset on a chart of 1840, and the use of ' see plan ' *in situ*, but without quoting its chart number, in 1850, in which year the use of roman black and egyptian lettering was introduced. Vertical hachuring continued, buildings were diagonally hatched, while sand and mud were stipples; rock and cliff representation followed the styles of 1822. Fathom lines up to five were shown by the equivalent number of dots with intervening spaces, the 10- and 20-fathom lines as dots with intervening dashes, and the 100-fathom line by continuous dots from 1835, when there was the first issue of a sheet of ' Abbreviations used in Admiralty Charts '.

A notable chart was Chart 1406, March 21, 1842, 'The North Sea from Dover to Calais and Orfordness to Scheveningen' by Hewett in the *Fairy*, 1831–40, with the banks and soundings within two or three leagues of the coasts of France, Belgium, and the Netherlands adapted from the surveys of Beautemps-Beaupré and Ryk. It used a datum of L.W.O.S. and gave notes of the tidal rise in various parts of the chart. An immense number of soundings was shown and their pattern indicates how the lines of soundings were parallel or starred. The apex or tail of a buoy symbol and a small circle in the hulls of light-vessels indicated their exact positions. There were anchor symbols with one or two flukes, and a vertical cross with a dot in each angle showed a rock which breaks. True compasses with a magnetic arrowhead were supplemented by marginal ticks to be joined across the chart to indicate lines of equal variation one degree apart. There were two vertical cross-sections of the sea bed, below a horizontal low-water datum-line, between England and the Continent.

Depths in feet rather than fathoms were used on Chart 103 of 1836, mentioned on p. 49; and in the following year, Beaufort, with the Board's approval, issued a circular instructing surveyors to show a five-fathom line on all detailed plans, within which line, soundings were to be expressed in feet. In another record of that year Beaufort said that all charts published under his directions had uniformly given the names of all places in the language of that country. This early attention to the much-vexed question of nomenclature is confirmed in early editions of *General Instructions for Hydrographic Surveyors* in which some principles were laid down. Notably, it was a subject that found a place in Copeland's letters to Beaufort from the Mediterranean. One other record of interest shows that in 1851, on a proposal of a Mr B. G. Sloper, Beaufort decided to apply a land-tint to some general charts only, while showing anxiety that the coastline detail would be obscured. A stipple land-tint is found on a chart published in 1855.

As stated, the engraving of chart plates continued in the hands of Messrs Walker, but the costs cannot be seen since they are included with printing, mounting, and so on, in the Estimates. The printing continued within the Admiralty. The chart catalogue for 1839 was printed ' for Her Majesty's Stationery Office ', this being the first mention of H.M.S.O., which had been established in 1786 and with which the Hydrographer's printing work was always to mean a close association. In a minute of 1841 Beaufort resisted a suggestion by the Comptroller of the Stationery Office, saying that there would be no means of preventing impressions of our most valuable charts being taken and sold if they were to be printed by contract out of the house. There followed objections, valid many years later, about the difficulty of making corrections to plates, the need for frequent proofs for office use, the risk of injury to the plates, and finally the greater expense of outside printing.

In November 1851 the answer to an official inquiry ran:

> Mr Loxdale, who is a letterpress as well as a copperplate printer, has the use of two Government presses and their paraphernalia on a floor above the Hydrographic Offices and employs workmen to print the charts etc., as required by the Hydrographic Office, on paper supplied on demand by the Stationery Office.

There followed a scale of charges such as double-elephant 4*d* per sheet, and corrections on stoppings 2*d* per sheet. It continued:

> The printing performed under this agreement is not considered to be done so well as it should be; the ink which is used will rub off, even after having been printed a month, the engraver complains that his work is not properly brought out, and the impressions delivered are frequently wrinkled and distorted by the press. These regulations were made by Mr Crofton Croker, when the chart printing was taken on charge by him in combination with the letterpress printing in January 1836 when a new copperplate press was ordered. The average number of charts and plans printed per week for the last twelve months is 1 222 including all sizes, but considering them as DE sizes that number would be 630. By the present arrangement the printing presses being in one of the highest rooms of the building and the plates being kept in the cellar, there is an obvious expenditure of time and labour in carrying every plate to be printed up and down stairs; besides there is a risk of injury from damp; and it would be worth while to consider in any future proceeding concerning them whether it could not be avoided. And it would perhaps conduce to the better performance of the printer's work, at the same time, if it were thrown open to competition.

Printing in the Admiralty in fact continued until 1855. The letterpress printing of Sailing Directions and the like was handled by H.M.S.O.

The chart catalogues show the increase in the published material. In 1830 there were 852 charts and 81 views, the latter mainly of harbour approaches and the like in the Far East. By 1839 there were 1 116 charts and 86 views arranged in thirteen geographical sections, with a fourteenth devoted to books. An important inovation was the numbering of charts consecutively through the 1839 catalogue, a step taken since the previous catalogue in 1832. Also given were sizes, e.g. double-elephant[1] and atlas, and the scales by the length in inches of a geographic mile or a degree of latitude. The title of the chart included its source and now its date, which thereby provided an excellent record of the then existing published material. Forty-eight charts had been compiled in the office. More than half the charts were smaller than DE/4 and more than a quarter were DE/8. Charts of England's west coast northward of Liverpool were still absent. There were fourteen Directions, thirteen remarks or memoirs, five Light Lists, of which the first volume was issued in 1832, and the Tide Tables. An interesting item is Chart 12, DE/8, m = 5·9, Shoreham Harbour, Lieutenant W. L. Sheringham and Michael Walker, 1829, at which date these two were serving in the office.

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[1] It was the practice to name a size of paper according to the watermark incorporated. Animals were used for watermarks, and hence ' elephant ' became the name of one size, which was used in Brussels as early as 1366 and in Venice in 1484. When a paper approximately double the size was made it was natural to call it ' double (the watermark) ', but two watermarks were not necessarily incorporated. The trade now knows a size between 28 by 23 inches and 34 by 28 inches as elephant and one between 36 by 24 inches and 46 by 31 inches as double-elephant. The Hydrographic Department soon adopted two standard sizes, one a double-elephant 38 by 25 inches and the other half that length known for convenience as ½ DE. These sizes have proved right for both producer and user, and the larger folded once to the dimensions of the smaller has standardized the sizes of folio covers and chart presses. However, such standard sizes when coupled with the standard scales for charts introduced later have severely taxed the cartographic art. A small number of charts of difficult geographical limits have necessarily had non-standard dimensions and very exceptionally there have been charts off the meridian.

In 1830 the title-page of the catalogue referred to 'Charts etc. constructed under the orders of the Lords Commissioners of the Admiralty, for the use of His Majesty's Navy, with the price at which Their Lordships permit them to be sold by R. B. Bate, Poultry, London'. By 1855 this had been shortened to 'Published by Order of the Lords Commissioners of the Admiralty'. In the same year similar details were given for the charts, of which there were 1 981 in fifteen sections, some 350 being DE/4 and a similar number DE/8. Some plans were included on coastal sheets and others were grouped on to one sheet. The average price of a DE chart was three shillings. References to the scale quoted mid-latitude. In Section XIV there were thirty-five Sailing Directions, ten tables, or rules, for compass correction, revolving storms, and the like, ten Light Lists, and one Tide Table. There is a record that, in 1848, the number of charts printed was 55 220, of which 22 819 were sold to the public together with 1 988 books. According to Washington's evidence there were 70 000 printings in 1852 and twice that number in 1855, sales being 27 000 and 64 000 respectively. In 1855, supplies to the Fleet were 225 boxes with an average of 300 charts in each. Sales produced £383 in 1827 and £1 140 in 1844, there then being a note in the Estimates that the credit for charts sold was paid to the Exchequer. Thereafter, the receipts are found in various documents (£1,010 in 1849) and are regularly available from 1885 in Issues Division's records.

The arrangement for a sole agent continued. Bate died in 1848 and the business was, after some departmental misgivings, carried on by Mrs Bate until 1853, when Potter took it over. In 1848 the Board approved the sale of charts at the principal custom-houses in the United Kingdom in addition to the various subagents at home and abroad; and in 1849 Beaufort showed concern that merchant vessels, particularly those on Government charter and conveying emigrants, should hold proper charts. The Marine Department of the Board of Trade was similarly concerned, as was shown by a memorandum of 1882[1] recapitulating their efforts in this direction since 1851. It contained comments of the Naval Professional Officer at the Board of Trade, a post filled on the Hydrographer's nomination and providing liaison between the two departments. Beechey was the first holder of the appointment, from 1850 to 1856.

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[1] Appendix C, 5.

The problem of promulgating new information affecting the charts and books after their publication was soon taken up by Beaufort and he was ably abetted by Becher. The first solution lay in the *Nautical Magazine*, which made its appearance under Becher's editorship in 1832 and for which, in its earlier years, Beaufort had to seek a financial subsidy from Their Lordships. Its prospectus[1] solicited new information ' from the numerous intelligent seamen of the royal and mercantile Navy of Great Britain ', mentioning in particular the discovery of new dangers. It announced that communications to Mr Bate would receive early publication in the monthly numbers. In November 1834 came the first 'Notice to Mariners' (not prefixed 'Admiralty' until 1915[2]), a series which has continued to be an essential channel of information to the users of Admiralty charts, Sailing Directions, and so on. A Notice of 1834 is shown overleaf, and facing it one of 1919 for comparison purposes. Beginning as Light Notices, they averaged one a week and were very largely concerned with new lighthouses, beacons, and buoys, which were specifically mentioned in a Return[3] to an Order from the House of Commons on this subject, dated February 1854. This commented thus: ' On receipt of official intelligence from either the Foreign or Colonial Offices, or other authentic sources a Notice is drawn up from it in the Hydrographic Office embodying all the particulars given that are important to seamen. Five hundred copies of this Notice are printed and distributed among the Naval Commanders-in-Chief at home and abroad, also to Lloyd's, to other Commercial establishments, and to the various Foreign Consuls resident in London .'

In the office, according to a record of 1841, small corrections to stocks of Admiralty and publishers' charts were made by hand in red ink; more extensive corrections by the pasting-on of reproductions of portions of the chart made from the plate, the latter being the first mention of the 'block corrections' in use to this day. The sales agent was expected to publicize new information, and on being challenged in 1842 about the publication of a new chart of the southern North Sea, to which reference has already been made, he replied that he had used a large placard. Superseded copies in agents' hands were replaced. Hydrographic Notices were a separate issue for new dangers to navigation and for the corrections of Sailing Directions, and were gradually replaced by the issue of supplements to the various books as noted in the Hydrographer's annual report for 1884.

The Admiralty *Manual of Scientific Enquiry* was another publication that sought to increase the incoming flow of information, and with which the

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[1] Bibliography 3, 1.

[2] See article entitled 'The Development of Admiralty Notices to Mariners and Radio Navigational Warnings' published in the *Journal of the Institute of Navigation*, Volume XI, No. 4.

[3] The earliest Return to have been found is dated March 1848 and is referred to later.

REVOLVING LIGHT

ON

THE MOLE OF ALGIER.

(Received from the French Government.)

NOTICE is hereby given, that since the 18th November, 1834, a *Revolving Light* has been substituted for the old Fixed Light, on the Mole of Algier; continuing throughout the Night, and the Light disappearing regularly every half-minute.

In fine weather, the Flashes may be seen at a distance of 5 Leagues.

The Light does not disappear *entirely*, at a less distance than 3 Leagues.

HYDROGRAPHICAL OFFICE.
ADMIRALTY,
27th December, 1834.

II

(12.)

No. **12.**

ENGLAND, SOUTH COAST.

Owers Light-Vessel—Replaced by Relief Light-Vessel.

Position.—Lat. 50° 37¼′ N., long. 0° 41′ W.

Characteristics of Relief light-vessel:

(*a*) Light:

Description.—An *alternating revolving white* and *red* light, similar to that of the permanent light-vessel.

(*b*) Fog-signals:

Description.—A siren giving *one* blast of about three seconds' duration *every thirty seconds.*

(*Notice No.* 12 *of* 1919, *dated* 1*st January.*)

Charts affected.—No. 2045, Owers to Christchurch, &c.
,, 1652, Owers to Beachy head.
,, 2451, Owers to Dungeness
,, 2450, Portland to Owers.
,, 2675*c*, English channel—eastern sheet.
,, 1598, English channel.

Publications.—List of Lights, Part I., 1917, No. 276.
Channel Pilot, Part I., 1908, page 241; Supplement 3, 1916.

Authority.—Trinity House, London. (*H. 5678/18*).

(13.)

No. **13.**

BALTIC, SWEDEN—STOCKHOLM.

Loudden Light—Alteration in Character.

Position.—Lat. 59° 20½′ N., long. 18° 08½′ E.

New abridged description.—Lt. Fl., *W & R*, *ev. 3 sec.*

Alteration.—The character of the light has been altered from group occulting with white and red sectors to *flashing* with *white* and *red* sectors *every three seconds.*

Remarks.—In other respects the light is unaltered.

(*Notice No.* 13 *of* 1919, *dated* 1*st January.*)

Charts affected.—No. 3498, Stockholm Skärgård.
,, 2362, Landsört to Gulf of Bothnia.

Publications.—List of Lights, Part III., 1918, No. 1877.
Baltic Pilot, Part II., 1914, page 308.

Authority.—Stockholm Notice No. 628 of 1918. (*H. 6665/18.*)

Hydrographer was concerned. Besides a hydrographic section contributed by Beechey, it covered astronomy, magnetism, geography, geology, mineralogy, meteorology, zoology, and ethnology. It was first published in 1849 with an introductory memorandum[1] stating that it would be to the honour and advantage of the Navy and conducive to the interests of science if more information was collected by the officers, particularly medical officers[2] on foreign stations, and added, ' . . . where ships of the navy are not present, it sometimes happens that the vessels of the merchant are conducted with much intelligence and enterprise '. An appendix quoted the Return to the House of Commons in 1848 about the ' coasts and islands of which our hydrographic knowledge is imperfect '. As has been shown, Hurd reported on the state of world hydrography in 1814, and the information in the *Manual* was kept up to date in later editions by the Hydrographers, concluding with Wharton in 1885. The frontispiece of the first edition was a chart of ocean currents by Beechey—a fine example of the copperplate printing of the day.

Beaufort and the department were active in the three scientific fields of astronomy, meteorology, and tidal theory. The Board of Admiralty continued to exercise their responsibility for the Royal Observatory and the Cape Observatory through the Hydrographer and instructed him to give effect to the royal warrant of William IV in 1830. At their first meeting under the new warrant in January 1831, the Board of Visitors, headed by the President of the Royal Society, accepted the services of Becher as their secretary; and the department has continued to fill this office. Admiralty direction was reaffirmed in 1835 and in 1837—Their Lordships agreed to pay the expenses of the Visitors and to the secretary's remuneration of £10 per annum. In March 1831, on Beaufort's advice, the Nautical Almanac Office again became separated from the Royal Observatory and was placed in charge of Lieutenant Stratford (Hind in 1853) under the Hydrographer's superintendence. The department arranged through H.M.S.O. the publication and sales of *The Nautical Almanac* by John Murray, who received ten per cent of sales according to a Return to the House of Commons in February 1854. For the invention of an artificial horizon, a reward of £100 was obtained for Becher in 1854.

In marine meteorology Beaufort's contribution is well known through his scale for recording the state of wind and weather. In 1833 Sir George Cockburn, a Naval Lord since 1818, congratulated him on it; and after being used for some years in the surveying service it was adopted by the Navy in 1838. In 1843 the department was ordered to supply barometers to all of

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[1] Bibliography 3, 2.

[2] Richardson, later Sir John Richardson, had served as an assistant surgeon in the Navy from 1807–13, and was a surgeon-naturalist with Franklin in 1819–22 and again in 1825–27. In 1847–49, while at the Royal Naval Hospital, Haslar, he led the search for Franklin. T. H. Huxley was a pupil at the hospital and was recommended by Richardson to go with Stanley in the *Rattlesnake* (see p. 61).

H.M. ships, and in 1846, surveying ships were instructed to take observations as desired by the British Association for the Advancement of Science, formed in 1831. By 1853, the Board decided that all ships were to keep a meteorological journal.

Surface ocean currents were discussed in 1840 on a proposal by Becher that drifting bottles[1] should be used, and in 1851 a general memorandum from the Board directed that bottle papers were to be issued with chart-boxes. Having been suitably inscribed, they were to be put in closely-sealed dry bottles for occasionally throwing overboard, an entry in the log being made. In 1853, the year when Maury[2] in Brussels was stressing the need for climatological observations over the oceans, Beaufort, in reply to a question raised on the subject in the House of Lords, stated that British ships should cooperate in any well-digested scheme, and that air and sea thermometers could be supplied to naval and merchant ships, the latter being selected by Lloyd's and Chambers of Commerce. He realized, however, the problem of dealing with a mass of observations, of separating the ' ore from the dross ', and of proceeding with the interpretation on some certain principles free from unsound prejudices. In 1854 Becher reported that in 1831 he had planned a series of monthly Wind and Weather charts of the Indian Ocean from log-book entries. Other work had, however, supervened, whereupon Beaufort had transferred the material to the Naval Office of the Board of Trade in the hope ' that its superior means would enable it to accomplish the great object which was judiciously planned and so courageously begun by Commander Becher '. Becher was also the author of an essay on revolving storms.

In the field of tidal theory, there was close cooperation with the Reverend Dr Whewell (later Professor, and Master of Trinity), at whose instigation, and subsequent to the successful organization to record times and heights of high and low water at coastguard stations round Great Britain and Ireland during a fortnight of the summer of 1834, Beaufort successfully sought in February 1835 Their Lordships' help for a governmental approach to European countries and North America, with the result that simultaneous observations were made in June that year on both sides of the Channel and the Atlantic. His letter concluded that if the proposal was approved he would ' lose no time in preparing detailed instructions and printed forms for the entry of the observations '. He was assisted by Dessiou in the office. In 1853 Beaufort reported on Whewell's proposal to the British Association on an Atlantic tidal survey and suggested a fast frigate, with whale-boats instead of guns on the upper deck, which would be left at various oceanic islands or salient points long enough for observations to trace the progress of the great tidal wave. Their Lordships presumably could not accept the estimation of two years and £10 000.

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[1] The use of drift-bottles by a Frenchman, Aimé, in about 1835, his instrument for measuring deep currents and his detachable weight for deep-sea sounding, were recorded by J. N. Carruthers among much else of historical interest in an article entitled ' Some Oceanography from the Past ', *Journal of the Institute of Navigation*, Volume 16, April 1963.

[2] Details of the remarkable career of Commodore M. F. Maury, U.S.N., LL.D., and of his contributions to international maritime meteorology are given in Dawson's *Memoirs of Hydrography*, Part II, and there are further references to him herein. Various biographies have been published. In 1841–42, when an Act of Congress established in Washington the Depot of Charts and Instruments, later to become the Naval Observatory, Maury was placed in charge of it. He resigned from the Federal Navy on the outbreak of the civil war in 1861, but geophysical and other scientific activities engaged him until his death in 1874 at the age of sixty-seven.

Other departmental activity was occasioned by the problem of compass correction in iron ships and by the introduction of railways and steamships. In July 1837 the Board approved Beaufort's proposals by setting up a committee on the defective state of steering-compasses in the Fleet. It made periodic reports, and in 1842 a Compass Branch associated with the Hydrographic Department was formed. Johnson was the first superintendent from 1842 to 1853, with a Mr Brunton at Woolwich Observatory. Navy Estimates for it included £3 745 in 1843, which decreased to £1 118 in 1849.

As for the railways, Beaufort had said in 1830 that the Admiralty should be consulted on any coastal constructions. At the end of 1845 he wrote of many Bills before Parliament being referred to the Admiralty for consent, and he recommended that there ought to be a distinct engineering department conducted by ' an officer of respectability sufficient acquainted with science and practice not to be imposed upon by specious representations '. Bethune was appointed to assist Beaufort, and in March 1846 the Board agreed that he should assume responsibility. An assistant and a consulting engineer were added in 1847, and all questions relating to railways, bridges, and other works that may interfere with, or injuriously affect, the harbours, rivers and navigable waters of the United Kingdom were considered. In 1850, there were two officers, three clerks, a draughtsman, and a messenger forming the Harbour and Railway Department, but as shown in the footnote added to the Order in Council of March 1851 the Harbour Department was reduced in December 1853 and placed under the Hydrographer, with an establishment of an engineer (Captain Vetch, R.E.), three clerks, a draughtsman, and a civil surveyor. The Harbours Act was passed in 1847. Vetch described the work in 1855 as the conservancy of the whole of the tidal waters of the United Kingdom. Later, responsibility was transferred to the Board of Trade by the Harbours Transfer Act of 1862.

From the departmental records, it seems the Hydrographer gave advice on many subjects. There was the Committee on Lifesaving Rockets and the Harbours-of-Refuge Commission. In 1833 Trinity House consulted him on centralizing the control of lighthouses, on the jurisdiction of the Cinque Ports and on the conservancy of the Thames. He was responsible for pilotage rates, and in 1853 for the siting and colour of lighthouses abroad. There are comments on the development of sounding-machines and deep-sea sounding (1844 and 1854), on the need to survey creeks and rivers on the south coast of England because of steam navigation as well as their possible use for smuggling or hostile purposes (1830), on time-balls (1837–39), on the Goodwins as an artificial island (1840), on the placing of lights in steam vessels (1846), on the need for coaling facilities at Portsmouth, Dover, and Newhaven (1848), and on a scale for the Ordnance Survey of Great Britain together with map styles and colours, as requested by the Treasury (1853). There was advice on pilotage services to Her Majesty, and how she could land at Osborne without passing through the inquisitive starers at Cowes (1845).

Afloat, surveys were progressed extensively at home and abroad, and under Beaufort's guidance the quality and scientific content of the work improved. In home waters, surveys were, according to Richards's *Memoir*, carried on in accordance with a systematic plan made earlier by John Walker, and based on the triangulation of the Ordnance Survey, with which department there was continuing cooperation. The number of surveys in hand round the United Kingdom increased from seven to nine or ten, reaching twelve in 1853, when a reduction had to be accepted, as will be discussed. In 1831 the *Fairy* was commissioned for surveys in home waters, and after her loss in 1840 she was succeeded by the steam vessel *Shearwater* as the principal ship on home surveys. The *Investigator* was paid off in 1836 after twenty-five years' service under Thomas; the *Mastiff*, home from the Mediterranean, took her place on the Orkneys survey, which was completed by Becher in 1847–48 after Thomas's death in 1846.

Around 1843 a number of small steam vessels was commissioned to take the place of the hired boats, the use of which had been adopted in Parry's time as an economy in naval resources. But hired boats again came into use when in the autumn of 1847 six vessels, including the *Shearwater*, named in a Return to the Order of the House of Commons dated March 1848,[1] were required to relieve the famine on the western shores of Ireland and Scotland. This important record, apparently the first Return of its kind, shows that the Return was in the form of question and answer. Giving details of surveys since 1838, it describes the coasts and so on of the United Kingdom where information was defective or incomplete, and estimates that to complete it ' in ten years more or less ' would require seven small steam vessels that had lately been employed, assisted by four boating-parties, some 500 men and officers. Beaufort later referred to the loss of the vessels as a very severe amputation. He no doubt had in mind their greater efficiency, since their replacement by hired boats meant that the number of surveys in hand did not in fact fall below nine. The *Shearwater* and the *Porcupine* were among the vessels diverted, and there was no principal ship on home-waters surveys until the *Porcupine* returned from operations in the Baltic at the end of the Crimean war in 1856.

Then, in 1853, Beaufort was obliged to reduce the costs of home surveys, which in the 1851–52 Estimates had risen to over £10 000 for the vessels and parties and to nearly £7 000 for the extra pay to surveyors. The future total was to be £7 000, although in aid of the cost of the vessels the sum of £5 900 was to be transferred from Vote 1, coupled with the reiteration that the system of hired vessels, boats, and men should continue as being in every respect more economical than commissioning small vessels for the purpose. It meant the enforced resignation of four captains (Bullock, Sheringham, Frazer, and Robinson) and one master (Taylor), and the reduction of one party that had just completed a survey. It also meant the establishment of a lower rate of surveying pay in home waters, which has continued to the present day. The new rates approved by the Board on Beaufort's recommendation in 1834, which also covered shore-based parties and duty, became (home rate given last): captains, twenty-one shillings (no home rate quoted); commanders, twenty shillings and thirteen shillings and sixpence; lieutenants in charge, fifteen shillings and ten shillings; first assistants, eight shillings and six shillings and sixpence; second assistants, six shillings and sixpence and five shillings per diem. Reminiscent of Secretary Croker's day, the last paragraph of the Board's letter said that surveying pay should be withheld until a certificate from the Hydrographer showed that all charts and Sailing Directions had been duly lodged at the Admiralty. Beaufort added an exclamation to the document that it meant no change whatever in any of the foreign surveys and he told his officers that the reductions were due to the increasing costs of the Navy.

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[1] Appendix C, 2 (Minute-book 6).

Hewett's North Sea surveys, including tidal work, in the *Fairy* were outstanding, and the loss of the ship with all hands in a gale in November 1840 was grievous. Denham, on completion of his work in the English Channel, was ordered to undertake his notable survey of the Mersey from 1833 until the publication of his report—*Mersey and Dee Navigation*—in 1840. His service was handsomely acknowledged by Liverpool Corporation as well as by Their Lordships, who specially promoted Denham to commander in 1835. The north-west coast of Scotland at last received attention, a question in the House of Commons resulting in a Return of November 1852, which recounted progress in these waters since 1845.

Abroad, an early step by Beaufort was to make an addition to the Hydrographic Instructions, drafted by the Hydrographer as heretofore for dispatch by the Board. It was made in the orders of September 1829 to Owen in the *Blossom*, with a copy to the Commander-in-Chief, America and West Indies, and ran: ' No senior officer who may fall in with Commander Owen while he is employed on the above important duties, do divert him therefrom or in any way interfere with him or take from him on any account any of his instruments .' This edict was included in the 1833 Naval Regulations and Instructions.[1] In December 1835 an Admiralty circular letter to commanders-in-chief abroad stated that appointments to fill death vacancies among commissioned officers and warrant-officers of surveying vessels were not at their disposal any longer. It is noteworthy in view of Fitzroy's later scientific career that, according to Admiralty records, it was Sir R. Otway who, on 13 November 1829, selected Lieutenant R. Fitzroy of the *Ganges* to take command of the *Beagle*, then employed surveying the southern part of the South America Station, with King in the *Adventure*.

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[1] Bibliography 1, 4. The edict is mentioned again on p. 228.

When, two years later, the *Beagle* was to continue her South American surveys, Charles Darwin, on 1 September 1831, signified his readiness to sail with Fitzroy as naturalist. Orders and instructions went out on 11 November, and the voyage, made famous by Darwin's work, ended in 1836 after circumnavigating the world. A concluding record is an item in the Navy Estimates for 1837–39: ' For completing the work of the *Beagle*'s survey in the office by her surveyors.'

Surveys were undertaken in the interests of defence and trade as well as science, and permission was obtained from foreign Governments, e.g. in 1834 through the Ambassador, Madrid, for the Spanish West Indies; or was refused, e.g. by the Emperor of Morocco, which resulted in the *Hecla*'s survey of Morocco's coast being broken off. In 1852 the Board's letter with the Hydrographic Instructions for Denham in the Pacific added, ' . . . strong representations had been made to H.M. Government of the rapidly increasing traffic between our Australian colonies and the western coast of America '. And in 1854 Beaufort, writing about the ownership of New Caledonia and the French and American penetration into the western Pacific, stressed the need for a fortified station at Cape York or Albany Island. There had been notable surveys in this area between 1841 and 1849 by Blackwood, Yule, and Owen Stanley in the *Fly*, *Bramble*, and *Rattlesnake*. It was in the *Rattlesnake* that T. H. Huxley served as surgeon-naturalist[1] as a curtain-raiser to his life's work in marine biology.

Denham's surveys in the Pacific and Australia lasted until 1859, and he advised on the organization of surveying units in the Australian colonies. To the south, there was the major survey of the New Zealand coasts, of which colony Fitzroy was Governor from 1843 to 1848, the year in which the *Acheron* sailed for five years' work under Stokes, assisted by two future Hydrographers, Richards and Evans. The *Fly*, Oliver,[2] was also engaged on this first hydrographic survey of the New Zealand coasts.

In the Mediterranean, activity was continuous in, successively, the *Mastiff*, *Beacon*, *Volage*, and *Spitfire*, under Graves succeeded by Spratt. The latter in fact surveyed in the Mediterranean from 1832 to 1863, and his eminently distinguished career, fully described in Dawson's *Memoirs of Hydrography*,

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[1] See p. 56.

[2] R. A. Oliver, not mentioned by Dawson, was captain of the *Fly* as a commander from 1847 to 1851, and surveyed in the South Pacific islands as well as New Zealand. He was a talented artist and his water-colours of scenes in these waters were exhibited at the Commonwealth Institute, London, in 1964. Oliver died in 1889, then an admiral.

Part II, included promotion to captain and the award of the C.B. for his work with the Fleet in the *Spitfire* during the Crimean war.

In the eastern Atlantic, Vidal conducted operations which disproved the vigia, Aitken's Rock, and charted Vidal Bank off the west coast of Ireland. In 1841–45, he surveyed the Azores in the *Styx*.

The Hydrographer continued to advise on expeditions, such as that up the river Tchadda, 1855, and corresponded with Scoresby on his Greenland work. Lastly, this brief review of surveys in Beaufort's period must mention another grievous loss in the death of Captain Skyring of the *Aetna*, who in 1833 fell in an affray with the natives in the neighbourhood of Cape Roxo, Africa, where he had landed for the purpose of obtaining observations.

The background to British surveys in foreign waters is well illustrated by the following two extracts in Beaufort's inimitable prose:

> Instructions to Barnett in *Thunder*, 1837. One great object which you will diligently pursue whenever you are engaged with the coasts of Cuba will be to explore the several remote and unsuspected passages between the reefs and thus lay bare those retreats which have so often covered the escape of the pirates. . . . In all your communications with any part of that extensive island you will provide for the more than common circumspectness and conduct in your officers and men, and as one of the means of not giving umbrage to that jealous people you should complete at once whatever you undertake so as to avoid a second visit to the same place. Besides the general and local instructions there is one other point to which it is my duty to draw your attention. Every fort battery or defencible tower placed near the shore will of course find its place in your survey. So likewise you should point out the most advantageous points for landing troops or field pieces. . . .

Letter to Sir William Parker, Commander-in-Chief, China, 31 January 1843:

> Sir, I was exceedingly flattered and obliged by your two very gratifying notes of September 3 and 11 not only from their kindness to myself but from the justice they so willingly do the assistance of the surveying vessels and to the zeal and gallantry of Kellett, Collinson and Hillyar. All three have reaped the golden fruit of your praise, and have to congratulate themselves not only on the chance which carried them to China but which placed them under the command of one who was equally quick in perceiving merit and just in requiting it. Belcher, who was ambitious of higher honours than his fellow workmen and who has been knighted by Majesty,[1] has just sailed from Portsmouth to join your flag, in the *Samarang*, in order to continue the coast of China. Sir John Barrow was much averse to the chance of irritating the Chinese by keeping our ships ' prowling in their waters ' but the Board clearly saw the concession to trade in certain of their harbours, most logically and absolutely conveys with it the right of free navigation to those harbours, and consequently the right of ensuring our traders from dangers by surveying. Besides when Captain Ross was for years surveying their south coast, neither natives nor Mandarins ever betrayed any symptoms of jealousy. In drawing

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[1] Beaufort's own knighthood came in 1848.

> up Sir Ed. Belcher's orders I made it imperative on him to consult you on the places he is to undertake first—as you could alone know what had been done and what is now above all, as I am well aware from our acquaintance here of the deep interest you take in all surveying operations and much more in those that will now spring out of this fortunate opportunity of extending our hydrographic knowledge—and I would beseech you my dear Sir William to give him occasional assistance when necessary, and sometimes perhaps the aid of a steamer which might effect more in a week in some places than all his own means in months.
>
> Since his orders were despatched Sir Robert Peel desired that he should take a cursory look at the Borneo coast and convey his report to you. I presume you will not let Belcher and Collinson serve on the same immediate ground. Kellett I suppose you have ordered home.

The previously mentioned Return of 1848 to the House of Commons gave information similarly on foreign surveys and the state of knowledge overseas. The Hydrographer stated that on an average over the last few years the Admiralty had employed eleven vessels and about 950 men, and that however incumbent on this country to take the lead in such efforts, still this amount of force if properly distributed and constantly employed may fairly be considered as our full share of that great duty which all maritime nations owe to the interests of navigation. He also recommended the placing of a competent person who ought to be a surveyor at the Hydrographic Department of East India House, and, while complimenting the directors, said that such an appointment and a moderate establishment would soon give a new face to Eastern hydrography, which had languished after Horsburgh's death in 1836. Foreign surveys were limited to some degree by the monies voted, and in December 1851 Beaufort wrote to the Secretary about an unexpected and discouraging cut of £10 000 in the Vote. He continued:

> But before you ultimately decide on such a cruel measure, permit me to bring to your recollection that the sum of £70 000 hitherto allowed for that important service was determined by a numerous committee of the House of Commons in 1848 after a full examination of the subject. I might add that since that period many of the members, even my economic friend Mr Hume, have said they would willingly see the maximum raised to £100 000. I will not trifle with your time by repeating here any hackneyed truisms about the comparative expense to the country in the cost of surveys or in the loss of ships and cargoes, but I will just entreat you to weigh the small sum you propose to save against the large amount of mischief which may be the result.

From 1849–50 the Estimates give a total cost of the surveying service by collecting items from Votes for pay, victuals, stores, and so on, to add to the items on hiring vessels and surveying pay. It reached £69 766 in 1852–53, a figure attained only by a successful representation to the Board that the *Herald* and the *Torch* in the Pacific devoted much of their time to general-service projects with the result that only half the expedition's costs were a charge to the Hydrographic Vote.

On more than one occasion Beaufort had to represent to the Board that there were insufficient promotions among officers of the surveying service despite a number attained on active service. In 1841 he made a comparison with those proportionately promoted in general service—at least three times as many. In 1853 the Board agreed to the promotion of a lieutenant and a mate every year, and a commander every alternate year. His thought for his officers had been described in the Centenary Lecture referred to earlier, including his dictum that Sunday was sacred to religion and rest. But when Drury used a concession to take his family to New Zealand in the *Pandora*, Beaufort remarked that wives were always conducive to mischief when on board.

The improved quality of the surveyors' work has been mentioned, and there is a record of 1841 to show the subject-headings that became embodied in *General Instructions for Hydrographic Surveyors*, e.g. nature of the shore, topography, views, soundings, deep soundings, currents, magnetism, wind and weather, charting the survey including the choice of scale, nomenclature, geology, Sailing Directions, the journal, natural history. This masterly document appeared as the first printed edition of *General Instructions*, which is in the Naval Library.[1] It is undated, but a note in the 1877 edition (Hydrographic Department Library) placed it at 1850. For half a century it remained substantially unaltered save for additions to later editions on account of contemporary developments. Surveys could convey a wide range of information if properly compiled and arranged. Soundings, although rated next in importance to the coastline, were to be full and precise, reduced to L.W.O.S., with a datum on shore, and accompanied by natures of the bottom. No-bottom soundings had their value. Orthography should use the acknowledged local names, and in their writing, names were to use the correct curvature. The scale of the survey might be from one inch to twenty-four inches to a mile, and be such as to show all the minutiae which may be required for navigation and also for reference by courts martial in case of wreck or stranding. The scale of the resultant chart depended on a variety of requirements of which the surveyor was no competent judge. Stress was laid on the necessity of projecting each day's work in order to avoid crowding or gaps. For hills, very open strokes of the pen were preferred to brush-work, provided altitudes were given. Another early record, on deep-sea soundings, instructed Barnett in 1844 to take them across the Atlantic using a pig of ballast and a long line of spun yarn numbered every 100 fathoms.

The surveying manual of the day was *A Treatise on Nautical Surveying; containing an Outline of the Duties of the Naval Surveyor; with Cases applied to Naval Evolutions and Miscellaneous Rules and Tables useful to the Seaman or Traveller*, by Commander Edward Belcher, 1835.[2] It was a remarkable compilation, demonstrating the author's practical and inventive turn of mind, and was not replaced until Wharton's standard work appeared in 1882. A knowledge of surveying at that date, as from the days of Cook and for several subsequent generations, was mainly learnt by practical experience under the guidance of the seniors officers conducting the surveys. Belcher had had only one voyage with Beechey before commanding a survey. A paragraph reads:

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[1] Bibliography 2, 4.

[2] Bibliography 2, 5.

> I shall now proceed with the various formulae, which were adopted for the survey of the west coast of Africa, and must beg to observe, that where a system has been pursued, differing from my seniors, such did not arise from a difference of opinion, or any fancied superiority in my plans. Had I been taught *any method* it is probable I should have adhered to it; but having my own ideas solely to guide me, without the aid of books, foreseeing the difficulties which would eventually arise from want of a system, in the registry of documents of such importance, I was led to adopt what I have not since had reason to depart from.

Besides much detail of how to organize a survey, there are descriptions of methods and instruments in use. Belcher's reference to the sextant has been quoted on p. 16, and the station-pointer was mentioned as a much favoured instrument, to which Belcher made a modification. He provided a semicircular centre and substituted a pencil for the sliding pin which tore the paper of the plot. Dalrymple's quincunx received acknowledgement, though the use of more than three ships was not contemplated. *Hints to Travellers*, later published separately, originated in the manual. There were several finely drawn illustrative plates.

Conditions on board received this comment: 'Although it may be imagined that the daily duties of the surveyor are arduous enough, yet his interest appears to receive fresh impetus as day closes and the stars begin to show; and he will probably be found watching their motions until dawn warns him that some little repose is necessary to perform properly the duties of the ensuing day.' But Belcher was evidently a hard taskmaster, as shown by the comment of a brother officer, Bethune, in a letter to Beaufort of 1845: 'How unfortunate it is that such a capital fellow for work should be such a devil incarnate with his officers.'

The manual covered operations with the Fleet:

> Having treated on the various points immediately connected with the duties of the surveyor, we now proceed to introduce a few remarks which may not prove unacceptable to those whose 'voices are for war', and endeavour to point out how the pursuit of surveying may be rendered of infinite importance in the conducting of warlike operations, by fleets or single ships as well as rendering the monotonous cruises of blockading squadrons of some importance by adding to the store of hydrographic matter. It may be suggested that this is travelling beyond our bounds . . . at the same time it is to be remembered that there is nothing to exclude the surveyor from his share of action, should he be present. He may in fact be called upon to perform the important duty of pilot; or, his surveying career

> terminated, may be selected for a command which may call forth all his energies in the manner of which we are about to treat; when the mind, practised in the details of surveying, arrives at rapid and correct conclusions of distances, and thinks light of difficulties which to others may appear insurmountable. ' Knowledge is power ' and the assistance of such a man to a commander-in-chief, of a similar turn, may possibly be turned to important use.

This description of a surveyor's role has had its echo in recent times. It was doubtless in the character of a man who served at sea from 1830 to 1852, while Beaufort was in the office—a period of service which was vastly productive and constantly turbulent. As an illustration, Beaufort's letter of 19 August 1845 to Belcher in the South China Sea has often been quoted. Its complete text is:

> Your last letter of April 8 is really all Hebrew to me; Ransoms and dollars; queens; treaties and negotiations? What have I to do with these awful things; they far transcend my limited chart making faculties, however well suited they may be to Admiralty Lords, to Commanders-in-Chief, to Governors of Colonies and to you; and with them my very good friend you must arrange your diplomatic enterprises, and to them you must look for applause. Fortunately the Board have not sent your dispatches upstairs, nor asked for my opinions which I beg leave to reserve for affairs of soundings, angles, and other humble things of that kind. That you may have been doing good service to the country I will not deny, but the harvest I look for at your hands does not stretch beyond the reach of a deep sea line and all the credit I crave for you, and through you for myself, must be won in the kingdoms of science and reaped in hydrographic fields. As I have no late drawings from you I have no critical remarks to offer. I am sorry to see the name Japan in your letter till what you had begun to the southward was finished.

Nevertheless. as has been shown, Beaufort was well aware of military applications. and when the Crimean war broke out he attached Brock and Sulivan to the Commanders-in-Chief, Mediterranean and Baltic, respectively. The services of Spratt in the *Spitfire* with the Mediterranean Fleet have been mentioned,[1] and in 1854 Beaufort was indignant that Sulivan had not been mentioned in dispatches, as without him the Fleet would never have reached Bomarsund. He later commented that the Commander-in-Chief had discovered that he would make little progress without the eyes of the surveying officers. In the same year he suggested that the Fleet should have a lithographic press afloat to supply plans to boats on war operations—a suggestion not put into effect until the 1914–18 war!

In the first volume of Admiralty Surveys, 1851–61,[2] there is a review of the period from 1832, and thereafter detailed reports in manuscript by the officers in charge of surveys. Printed 'Return of Survey' forms were introduced by 1856, and, in later annual volumes, tracings of areas covered were included. At the conclusion of the Beaufort period there were in hand ten surveys in home waters and eleven abroad, three of which were parties with the Fleet in the Baltic and the Black Sea. They were under six captains, eight commanders, two lieutenants, and five masters.

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[1] See p. 61.

[2] Bibliography 2, 2.

In March 1854, on account of age, and failing eyesight, hearing, and memory, Beaufort wrote of his forthcoming retirement, but a week later the Board said they could not spare him yet because of the wartime activity. On 24 January 1855 he asked for his resignation to go before the Board, and his successor, Washington, was appointed five days later. Beaufort was then a rear-admiral with a K.C.B., and was eighty years of age. He was a Fellow of the Geological Society (1808), the Royal Society (1814), the Astronomical Society (1820), and the Geographical Society (1830). The Admiralty allowed him to live at number 7 Somerset Place in 1833; and from 1837 the Hydrographer received £300 in lieu of a house in addition to his salary of £500 per annum.

Reporting on his predecessor's meritorious service, Washington remarked on the systematic examination of our coasts being set on foot, including the North Sea and the Irish Sea; the surveying in Canada, Nova Scotia, the West Indies, New Zealand, the Greek Archipelago, South America, the west coasts of Mexico and California, and the coasts of China and Borneo; and the raising of the Hydrographic Office of England to a far higher level than any similar institution in Europe.

1855–1863

Washington was appointed Hydrographer and Head of Harbour Department on 29 January 1855. His first surveying appointment had been in 1841, as a commander, to the *Shearwater* in home waters. His interests had always been scientific, which led him to seek opportunities to travel extensively and to study languages. From 1836–41 he acted as secretary of the Royal Geographical Society. He had had assignments connected with the department, one of these including visits to the hydrographic offices in Paris and St Petersburg shortly before he became Beaufort's assistant in 1854, at a time when the Crimean war brought the department under heavy pressure. Throughout his term of office, Washington had the able and experienced Becher as his chief assistant, Becher taking charge when Washington was away, on for instance his visit of inspection to the coasts of Egypt and Syria in 1860 and during his final period of ill health.

The war continued until 1856. At the end of 1855, Washington had to explain an overspending due to the supply of Baltic and Black Sea charts to our French allies, 70 000 more charts being issued in 1854 than in 1852.

Moreover, there were eight additional surveying officers acting as pilots to the fleets in those waters.

In the Far East, there was the second Chinese war from 1856 until the Treaty of Tientsin in 1858, which was followed by further fighting to enforce it and to establish the Chinese Imperial Government. It was in this fighting that ' Chinese ' Gordon achieved fame; and Bate was killed at the capture of Canton in 1857. Washington could well have had a premonition when some months previously he wrote: 'Do not unnecessarily expose your life, the Chinese are not worth it.' Bullock temporarily took charge of Chinese surveys, and later under Ward was in the Yangtze operations with the *Dove*, with the result that in a letter of December 1860, typical of the period, Washington wrote to the Commander-in-Chief, Sir Charles Hope:

> Commander Ward writes in the most gratifying terms of the valuable aid you have rendered him by the loan of three gunboats and I must be allowed to thank you in the name of all surveyors for the handsome manner in which you have mentioned him and his staff in your public despatches, the more valued as it is rare.

He continued:

> The telegram giving the account of the attack on Pekin has just reached London and that it is intended that the troops should winter there and at Tientsing. This decision will probably set some of the squadron free and you may be enabled to make an expedition to Japan, which the First Lord tells me is probable. I have therefore sent by this mail a duplicate set of all the Admiralty charts of those coasts (which are very meagre) and a copy of all the American surveys which may be useful. I have sent the same to Captain Ward in case he should go there, and indeed there is no part of the station on which he could be more usefully employed as we are in a state of utter ignorance of these coasts and seas and I tremble when I hear of ships going there and dashing through the Suwo nada. But there is work for half a dozen vessels instead of two.

Japan was still resisting the entry of foreign trade; and in 1861 the Foreign Office also advocated British coastal surveys.

In 1858 Washington supported the proposal for a naval base at Singapore, commenting on the various sites and pointing out that, whereas the Dutch had a base at Surabaja, we had no dock nearer than Bombay or Port Jackson. Iron screw steamers needed to examine propellers and to clean and coat their bottoms. Nearby, J. Richards surveying the Gulf of Siam had his ship the *Saracen* repaired free of cost; and Washington thanked the King of Siam for his courtesy. India was shaken by the mutiny of 1857, and in the following year all responsibility was transferred from the East India Company to the Crown.

A consequential and seemingly natural step was an arrangement in March 1861 between the Secretary of State for India and the Admiralty whereby the whole of the marine-survey, chart, and hydrographic business of the Home Government of India should be undertaken by the Hydrographer acting for the Imperial Government. Washington appreciated what was involved and had the opportunity of introducing proposals that included the assistance of Indian naval officers on furlough in England to formulate what was required, and of bringing Sailing Directions up to date. After correspondence with Commodore Wellesley at Bombay, he made proposals to the India Board in 1862 for the use of Indian naval ships and personnel under over-all instructions from the Hydrographer—proposals that if accepted, ' would be the finishing stroke to the useful and important labours already executed '.

There had, however, been a recent lean period for Indian surveys, to which Beaufort, for one, had referred in 1848,[1] owing in part to Horsburgh's post as Hydrographer being allowed to lapse on his death in 1836. Then, on the abolition in 1862 of the Indian Navy and the resurrection of the former title of H. M. Bombay Marine, there followed, for one reason or another, a further period of inactivity afloat. In the department, original material was taken over from India House, and some publication of charts and Sailing Directions undertaken. The arrangement lasted for thirteen years, when it was replaced by another, as described later, although it, too, did not last long.

The development of Australia included coastal surveying, and in 1860 the House of Assembly in Victoria offered to pay half the cost, constraining Washington to comment that it was the first time such an offer had been made to the Admiralty. The following year saw an agreement whereby New South Wales, Victoria, South Australia, Tasmania, and Queensland would provide for local expenses and locomotion, and the Admiralty for salaries, instruments, and the ensuing chart production. The surveyors were to receive instructions from the Hydrographer but were to consult with the Surveyor-General of the colony, the emphasis being on surveys of wide rather than local interest. Like his predecessor, Washington advocated the settlement at Cape York, likening it to the Singapore of the area. And in March 1859 he was in favour of accepting the natives' offer for Fiji to become a British possession, having in mind the Panama–Sydney mail route and the French and American activity.

In Africa, Livingstone, after sixteen years' work for the London Missionary Society, went out again early in 1858 with an expedition under the aegis of the Foreign Office to extend trade and civilization. Skead, of the Cape-of-Good-Hope survey (begun by Dayman in 1853), was instructed to join the *Pearl* and assist in landing the expedition, which meant first finding a suitable entrance to the Zambezi. Washington did much to help Livingstone with the provision of personnel and craft; so much so that in a letter written in 1860 he recorded: ' Hydrographer does all the work for the Foreign Office .' Livingstone did not heed his warning that Bedingfield was, as it proved, an unfortunate choice as the senior naval officer in the expedition. During 1862 there were discussions with the President of Liberia on his coastal territory's delimitation. In the Mediterranean, the Suez Canal project meant a survey of those parts of the north coast of Egypt, ' at which it is probable the Mediterranean entrance of the proposed canal is to be made '. The survey was off the Damietta mouth of the Nile, and the instructions of February 1856 to Mansell in the *Tartarus* mentioned that the Hydrographer had had the advantage of discussion with Mr Rendel, England's engineer-in-chief on the joint commission; and the results of the survey were to be treated as confidential. Thirteen years were to pass before the canal was opened.

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[1] See p. 63.

In North America, G. Richards, who was surveying the vicinity of Vancouver Island in the *Plumper*, was, in 1857, appointed Second Commissioner for the boundary between British and American territory. The American Civil War (1861–65) involved an increase in chart printings, and plans were made in 1861 for the employment of surveying officers should Britain become embroiled.

At home there was the advent of the telegraph in 1861, ten years after its introduction in America, where Professor Morse had invented it in 1837. It proved useful for the time-ball service and communications with chart depots. In April of the same year an invention for electric light was proposed to the Admiralty for masthead signals, for throwing a light, and so on, on which Washington remarked that he was not aware of any purpose not sufficiently covered by common lights now in use, and at anchor a special engine would be necessary. Indeed, one duty of an office messenger continued to be keeping candlesticks supplied—a practical electric lamp was not available until 1879.

Lastly, but by no means least in importance, was the need for information on oceanic depths, initially of the Atlantic, for telegraph-cable laying. (The first submarine cable was laid in 1850 from Dover to Calais.) The persistent American proponent of a transatlantic cable, C. W. Field, had in 1854 obtained the views of Maury, who was to maintain his leading international position in oceanography under the Government of the Confederate States during the civil war. Maury thought the project practicable, given a sea smooth enough, a wire long enough, and a ship big enough, and he said that Lieutenant-Commander Berryman, U.S.N., had taken a series of soundings and bottom-scrapings from Newfoundland to Ireland the year before.

Berryman ran another line of soundings two years later; meanwhile, at the Royal Society, Thompson, Faraday, and Bright had supported the project. In 1856, Field asked the Admiralty to determine its own soundings, and in his comments on Field's letter, Washington expressed the need for a steamer of 200 tons having a six-foot-diameter reel driven by a 4 h.p. engine for heaving in and reeling up the line, of which there was to be some thousand fathoms (some of silk), leads of 60 to 120 lb, and a Massey sounding-machine, which in 1832 had reintroduced Hooke's use of revolving vanes.[1]

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[1] See footnote [2] on p. 17.

He continued,

> Superficially viewed deep soundings are of little importance to navigation but considered closely they are essential to the perfection of our charts. For they remove from them or substantiate the existence of the numerous dangers which disfigure them, called vigias, handed down to us by the old navigators. . . . On the whole, the subject is one that should no longer be disregarded by the first maritime State of the world; more especially in these days when such enquiry is going forward about us, and when the eye of science is prying deeply into the hidden works of the Creator in the construction of our Globe.

Accordingly, Dayman in the *Cyclops* took soundings in 1857 from Dingle Bay to Newfoundland, and in the following year assisted at the abortive attempt with cable embarked in the British *Agamemnon* and the American *Niagara*. The plan entailed a splice in mid-Atlantic, but the first half of the cable parted when only 200 miles from Ireland. In August 1858, another attempt by the same two ships, assisted by the *Gorgon*, Dayman, and the *Porcupine*, Otter, was successful. This time the splice was made first, the ships steaming apart from mid-Atlantic to their respective shores. Celebrations were short-lived: the cable became inactive within a month.

The next step in England, where overseas communications were understandably rated highly, was the setting-up of a Board of Trade committee, which reported favourably in 1863, as mentioned in the Richards period. However, in 1860, Washington gave detailed instructions to Captain Sir L. McClintock in the *Bulldog* for soundings via the Faeroe Islands, Iceland, and Greenland to Labrador; Reed was appointed surveyor. Oceanographic observations of current, temperature, and variation received mention; later, Washington wrote that the greatest depth obtained was 2 000 fathoms, and that on one occasion one large, living starfish and several small ones were brought up from a depth of 1 200 fathoms. The question whether life could exist at that depth was thus settled.

It is not clear if detachable weights were used. In 1838 the Frenchman Aimé had arranged to release weights by sending down a messenger, and in 1854 an American, Ensign Brooke, encouraged by Maury, invented a lead from which weights became detached on striking the bottom. A similar British invention was made on board the *Hydra* in 1867;[1] and Wharton's manual of 1882 referred to Brooke, Hydra, and Baillie rods, saying that the Baillie was used in the *Challenger* expedition of 1872–76. Soundings were also taken for cables in the Mediterranean (1857), and from England to Gibraltar (1859), but, in 1858, having advised a cable company that as there was no surveying ship in the North Sea they should hire a master in the Hull–Hamburg trade to carry the vessels in a straight line to Heligoland, Washington told the Board that cable-laying was past its infancy and naval help was now uncalled for in such operations. In 1863 he estimated that the cost of soundings had amounted to £70 000, showing some restlessness at the time spent by surveying ships on the work. It is of interest that Dayman in 1859 was told that W. Siemens, the well-known electrician, was to take passage in the *Firebrand* for the purpose of testing apparatus for determining depth without a line. When Washington later referred a similar proposal to the Astronomer Royal for comment, the reply was that it would be better to throw £50 into the sea.

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[1] See p. 83.

In November 1855 a committee was formed to inquire into the present state of the office of the Secretary of the Admiralty.[1] Washington's evidence confirmed the arrangement for his correspondence whereby original Hydrographic Instructions and orders for a ship to change her station were signed by the Board, and letters to authorities such as the India Board or Colonial Office by the Secretary; otherwise the Hydrographer conducted his own correspondence, keeping copies in minute-books and letter-books and endeavouring to keep their number down (4 000 out and 6 000 in per annum) 'in order to get on with chart production'. Expenses were submitted at the time of the Navy Estimates. In future, the checking of monthly accounts (£700 in a year) would be done by the Accountant-General, which thus ended the long-standing arrangement with the chief clerk, Dyer. To avoid delay, the necessity was stressed for keeping records in the department rather than in the Record Office.

Finally, Washington took the opportunity of complaining about the accommodation, saying that space at Paris and St Petersburg was as much as at the whole Admiralty, though he admitted that the former had the disadvantage of being as far from the Minister of Marine as Somerset House from Whitehall. A few months earlier he had described the accommodation as inconvenient, unwholesome, and unsafe. Nearly every room was occupied by two or more persons. The width of the passages had been reduced to four feet and a half by chart-boxes on either side; and gaslighting, necessary all day, greatly increased the risk of fire to the invaluable original documents. One approach was by a winding staircase, near the top of which was a water-closet used by the messengers; in midsummer the stench was occasionally intolerable. In three hours on the previous day Washington had been visited by Admiral Lord Radstock, Rear-Admiral Earl Spencer, Vicomte de Chabannes, Lord Duncan, Sir Archibald Campbell, and Admiral Sir Charles Ogle; their general comment was: 'What a disgrace that the Hydrographic Office should be lodged in such a rookery.' The printing office was worse, and had an even greater fire risk.

Washington had had a definite promise from Sir J. Graham that the roof of the main building would be raised and the attics appropriated for documents and the library; and that the alterations could be carried out in four months without disturbing departmental work or interfering with those in the wing buildings. Evidently, this was done before the receipt of a precept of the

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[1] Appendix C, 4 (Misc. 12).

House of Commons in April 1861, which inquired about the number employed with their designations, salaries, and hours of attendance, and the number of rooms they and the records occupied. The answer was that the Hydrographer (£800), Chief Naval Assistant (£300), and Assistant Hydrographer (£350) each had a room. Four naval assistants (£236–180) were in two rooms, one small, while the fifth and the Superintendent of Compasses, part-time (£182), made do with a garret in the roof. Five draughtsmen (£280–150) and one from the Harbour Branch occupied one room, and the four packers or messengers (£95–60) another small room. The records were in seven garrets in the roof, while charts were distributed in presses in all rooms and passages.[1] Hours were ten to four, the Hydrographer's eleven to five.

A first step by Washington was to report in March 1855 on the Compass Department and observatory at Woolwich, giving some historical details, stressing its importance—' now that steamers dash along at ten to twelve miles an hour '—and noting the current discussions on the use of correcting-magnets in iron ships, at the British Association for the Advancement of Science. He showed that masters of flagships had been swinging ships at naval ports, and Johnson those at Greenhithe until he died in 1853, when Mr Brunton had carried on. This report resulted in the appointment of Evans as superintendent; his advancement from master to commander or captain, as being more appropriate to his post, was pressed for in 1859 though not achieved until 1863. In 1859 Evans produced a variation chart of the world, such charts for the Atlantic, the Pacific, and the Indian Ocean having previously been produced.[2] The annual change was given, and Washington commented that the chart was a great advance on the inaccuracies in foreign charts.

The staff of the department proper slowly increased. Washington obtained Sunday pay for naval assistants while the Crimean war continued, and periodic improvements in the conditions and pay of the draughtsmen and messengers. In 1856 the naval assistants were Becher, Dunsterville, Burdwood, Barrie, and King, and the draughtsmen M. Walker (chief), T. Walker,

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[1] This accommodation was identifiable in 1963 as the second floor, with attics above, in the central part of the U-shaped building with courtyard facing Whitehall, being the third Admiralty on the site dating from 1725. Washington's use of ' rookery ' in his description seems an exaggeration in these days of the skyscraper, and since the rooms were of good size it was necessary to remember the mass of documents and the printer's paraphernalia as well as the absence of skylighting, which was added much later with other improvements to the attics. Parry referred to printing ' upstairs ', which showed that he, and presumably his predecessors, were not above the first floor. Beaufort referred to Board papers' being sent upstairs to him, which may mean that the then four rooms of the department were up on the second floor, the move possibly occurring when the Admiralty Boards were reorganized in 1832. Richards's application for sun-blinds showed that in 1868 he and the draughtsmen faced westwards over the Admiralty garden where the new building was to be erected at the turn of the century.

[2] There had been variation charts of the Atlantic in 1701 and the world in 1702 as a result of the 1698–70 expedition of the *Paramour*, to command which, Edmond Halley, magnetician, was specially given the rank of post captain. Later, from 1720 to 1742, he was Flamsteed's successor at the Royal Observatory.

Berningham, Horsfield, and Powell. Higgins retired in 1855 at the age of seventy-seven after fifty-seven years' service; Michael Walker retired in 1861 after fifty-two years' service and was succeeded by a naval assistant, G. A. Bedford, with the title of Assistant Hydrographer, a title by which John, and then Michael, Walker had been alternatively known. The post of chief draughtsman now lapsed until 1864.

A sixth naval assistant was added in 1857, and a fifth draughtsman in 1860. In January 1862 Washington made proposals that resulted in the Order in Council of 19 July 1862, which sanctioned an establishment of Chief Naval Assistant (Becher), five naval assistants, a new post of Superintendent of Charts (Bedford), six draughtsmen,[1] i.e. one first class (T. Walker), two second and three third class, and four messengers. It was shown that the original documents numbered over 20 000, that the Chief Naval Assistant had 800 chronometers in circulation (packing and dispatch as well as maintenance was done by the Astronomer Royal from 1856), and that the five naval assistants' work was broadly subdivided into: (1) correspondence, accounts, instruments; (2) chart supplies and catalogue, Light Lists; (3) Tide Tables; (4 and 5) Sailing Directions, Hydrographic and Light Notices. The draughtsmen worked on a geographical basis, there being 80 to 100 new charts a year, with corrected charts more than one a day. Presumably Burdwood continued to be responsible for tidal work, and Dunsterville the work of Sailing Directions Room. The earliest interleaved copy of Sailing Directions—a method still in use for recording incoming information—was one of *North Sea Pilot*, Volume I, 1857. Dunsterville had to be lent temporarily to Somerset House in 1862 to advise the Accountant-General on pilotage rates, which were to become the Hydrographer's responsibility in 1867.

There were two other major changes. The Board decided in November 1855 that printing of charts in the Admiralty should cease, and be transferred to Messrs Malby, who for many years had mounted the charts. Coppers were to continue in the basement of the Admiralty when not in use. Then, following the Harbours Transfer Act of 1863, the Harbour Department was transferred to the Board of Trade, which left the royal harbours with the Admiralty. Furthermore, the Hydrographer's responsibility for the Admiralty Library became clear in 1856 when he reported its cataloguing; in 1860 he explained to the chief clerk how purchases were made on the authority of Board members, Secretary, or chief clerk, and by the Hydrographer who needed books of voyages for writing Sailing Directions, obtaining them through the Admiralty chart-agent at twenty-five per cent below cost price. The librarian made an annual report through the Hydrographer, who now recommended that the estimate should be increased from £100 to £200, and that this sum should be laid out regularly on new purchases. The earliest known record of the library was in July 1828 when Parry was authorized to accept and keep books presented by George IV.

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[1] There is a copy in Minute-book 12 of the qualifications required of the draughtsmen by the Civil Service Commissioners (1855), dated 28 November 1863. The qualifications covered handwriting, arithmetic (including vulgar and decimal fractions), geography, projections, drawing and copying by squares, and, desirably, some modern languages for translation purposes.

Chart production proceeded vigorously, and between 1855 and 1864 the number published, according to the catalogues, increased from 1 980 to 2 500. Increases at home were on the Scottish and Irish coasts, and abroad, on the coasts of the North Atlantic islands and north-east America, China, and latterly Japan. Sizes larger than DE appeared, plans were inset or grouped on a sheet, and views were embodied though some separate sheets of views remained in circulation. There were still more than 200 and 400 respectively of charts smaller than DE/4 and DE/8. The catalogue continued to quote sources, and showed that a great number of charts had received additions or corrections. At one period, surveying officers on half pay and ten shillings per diem[1] helped the draughtsmen in preparing work for the engravers. Richards, in his *Memoir* of 1868, inclined to the view that progress had been almost too rapid. The use of photo-reduction techniques was discussed with the Ordnance Survey, who were asked to reduce two plans of Victoria and Esquimalt in 1861 with a statement of costs; but the method was not adopted in the department.

The cartography of the day was considerably more legible. Chart 1610, 'Thames Entrance', July 1855, showed more severely selected and bolder soundings, drying heights, heights and visibilities of lights, backed one- to three-fathom lines, and buoy topmarks. It introduced a natural scale. Chart 147, 'Helford River', 1863, introduced the magnetic-compass rose with the annual change of variation; and the bearings of leading lines and the like were shown as magnetic. Chart 267a, 'English Channel', 1859, had red dots and yellow flares at the positions of lighthouses. Names of the ship and her officers were given in the titles. Abbreviations 'ED' and 'PD' were used. J. and C. Walker were the engravers. Coastguard maps were produced in 1858, and the Wind charts of Lieutenant Maury, U.S.N., were mentioned in the 1864 catalogue, edited by Dunsterville, published by order of the Lords Commissioners of the Admiralty, and printed by Eyre and Spottiswoode for H.M.S.O. A DE chart was priced at two shillings and sixpence to three shillings. A new chart-paper was accepted from H.M.S.O. in 1858, but the former quality continued in use as better for those charts (one-third) mounted on linen.

Sailing Directions were additionally written by surveying officers on half pay and ten shillings per diem, e.g. Richards, Belcher, Fitzroy; and by 1864 there were fifty-seven such books. Against Horsburgh's *Directory* was a note that it had been edited and corrected by Dunsterville, and it sold for ninety shillings, whereas ten shillings was an average price for a volume. Lists of Lights and

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[1] Bibliography 1, 7.

Tide Tables remained at ten and one respectively, and there was a number of navigation and compass tables.

Corrections to charts and Sailing Directions continued to be by Notice to Mariners, which, from 1861, quoted the charts affected, and by Hydrographic Notices. From 1858 there was bi-monthly promulgation of information on new charts and publications.

Issues of charts and books to the Fleet was made as heretofore through superintendents of ports at (1855) Bermuda, Halifax, Jamaica, Simons Bay, Hong Kong, Gibraltar, Malta, Trincomalee, and Rio de Janeiro, and at home, Deal, Sheerness, Portsmouth, Devonport, Woolwich, and Queenstown. The number of boxes in circulation was over 400, each box containing some 300 charts and books. Sales continued through the sole chart-agent, Potter, and his subagents, twenty-four at home and thirty-two abroad as listed in the chart catalogue, although the sole-agency arrangement was challenged from time to time.

In November 1860, H.M.S.O., with its over-all responsibility for Government publications, also took over the sale of charts, but only two months later asked to be released from the Treasury ruling owing to the consequent need for extra staff and so on. Thus Washington had to cancel instructions he had sent to Potter, Malby, and the Nautical Almanac Office. Just previously, Washington had tried to have receipts for sales offset against printing costs, as was indeed the original intention, but was unsuccessful, since he later complained that charts sold to the public entailed a loss on the Navy Estimates, of which the public reaped the benefit; and there was less incentive to sell Admiralty charts. The availability of Admiralty charts to the mercantile marine, and their correction for the latest information was discussed at length in 1860 with the Board of Trade, where Sulivan was now the Professional Officer, and with the local Marine Board at Liverpool. The organization was carefully explained and some misconceptions corrected.

Admiralty charts were admittedly open to improvement and so could not be a standard for comparison. It would be a case of the ‘ blind leading the blind ’, and ‘ indeed hydrography has benefited by private enterprise ’. If the use of Admiralty charts was enforced, the Admiralty would be ‘ liable to be told in cases of wreck that they were occasioned by the Admiralty charts ’. Some charts were in fact made for mercantile-marine use. Agents preferred to sell the higher-priced, privately published charts. The upshot was a circular letter to agents signed by the Hydrographer for the Board in February 1861.[1] It covered the backing of charts, the use of both Hydrographic and Light Notices, the colouring of lights, and the introduction of correctional arrangements at all agencies. In 1862, 140 000 charts were printed, of which some 75 000 were sold to foreign Governments and the public. In that year the department's estimate was £14 000. Sales were around £5 000 in 1858, annual figures only becoming regularly available in Issues Division's records from 1885.

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[1] This letter is reproduced in full in Bibliography 1, 6, as its provisions remained in force for many years.

During this period, there was a larger number of surveys in hand under the Hydrographer's direction than at any other time in the department's history. There are concise details for the years 1858–68 in Richards's *Memoir.* In 1858, when the Crimean-war dispositions ended, there were twenty-one, and in 1861 and 1862 there were twenty-four under eight captains, seven commanders and nine masters. The ten home surveys used hired crews, whether in ships or boats, as did some in the Colonies, including the five in Australian waters. From 1858, the *Porcupine* was the principal ship in home waters. There were five commissioned R.N. ships abroad, Japanese waters receiving a first mention in 1862. There were nine steam vessels. The cost of surveying pay, hire of vessels, and so on reached a maximum of £40 000 in 1863, and of H.M. ships £73 000 in 1861, though much of the latter was charged to Votes 1 and 2, which was reasonable enough owing to their frequent employment on general-service duties.

Washington revised *General Instructions for Hydrographic Surveyors* in 1862, making a number of additions. The topographic details required were enlarged to include the heights of lighthouse lanterns above H.W.O.S. or M.W.L. On soundings he said: ' The importance of sounding is not sufficiently considered by young surveyors; the officer in charge is often deterred from advancing young assistants to take a share in the triangulation of a country from knowing that they would consider it beneath their dignity to be sent to sound when they have once been trusted with a theodolite.' (Evans omitted this sentence in the next edition of 1877.) On large scales, soundings were to be run in close sections, and each irregularity was to be examined. The paragraph on tidal observations for reducing soundings and obtaining the establishment was in more detail, and referred to Dr Whewell's chapter in the Admiralty *Manual of Scientific Enquiry* on tidal streams and the tidal wave. On deep soundings there were references to recent experiences, such as those in the *Cyclops* and the *Bulldog.* Currents and deep currents (1¾ knots at 120 fathoms had been observed), their relation with temperature, and the means of measuring them, were discussed. On the question of scale Washington differed from his predecessor and his successor in calling for an opinion from the surveyor on the scale of the resulting chart. There was additional advice on orthography, covering the use of English consonants and acute accents with the note: ' The variety in spelling that now disfigures even some of our best published maps and charts is far from creditable.'

Washington's instructions to Mansell in the *Tartarus,* 1856, showed the development of methods:

> Off the mouth of the Damietta River, the survey should be very detailed and lines of soundings in parallel sections at right angles to the shore, should

> be run off at a cable's length apart from the beach out to 10 fathoms depth. The immediate inshore work must be done in your boats but I should recommend the sections from 2½ out to 10 fathoms to be run in the ship at half speed which you will find an expeditious and much less fatiguing mode of sounding than in boats. Indeed while your boat parties are away inshore there seems no reason why the ship should not be running these off-shore soundings.

Washington, the geographer, added that Mansell was at liberty to carry three watches to Jerusalem, which, apart from its sacred associations with the City of David, was of much importance as a starting-point for travellers; and he might continue another twenty miles to the shore of the Dead Sea! Returns of surveys, sent in annually on a newly devised, printed form, have been preserved in the department's records.[1]

In order to speed the department's work, surveyors were encouraged to send in fair sheets reduced from the scale of the survey to the scale on which the work ought to be published. This differed from Beaufort's view that only the office could decide the published scale, and Washington gave the surveyor freedom to leave it to the office. Views were to be sent in on separate sheets so that the view engraver did not need to handle the fair chart. Bedford's chart of Loch Awe in 1861 (Plate X) was considered by Washington to be one of the most beautiful ever sent in, and he proposed to place it in a conspicuous position in the International Exhibition of 1862 as a specimen of Admiralty coast survey. It was drawn by McDougall, but a similar chart of Loch Sunart, 1864, was drawn by Sharbau, and the titles of the two charts showed that at this period the assistants afloat included draughtsmen, e.g. Sharbau and Stafford. However, the amount of time that a hydrographic surveyor should devote to detailed topography, when a land surveyor has not preceded him, has been of recurring concern to Hydrographers.

Rates of surveying pay and allowances were re-established in a Board memorandum of February 1862, given in full in Bibliography 1, 7, since it illuminates various conditions of service, the continuity of surveying pay under certain circumstances, the writing of Sailing Directions, travelling- and lodging-allowances, and finally the institution of a clothing-allowance for crews if extraordinary wear and tear had been incurred.

Washington revised the appendix in the *Manual of Scientific Enquiry* concerning the coasts and islands of which hydrographic knowledge was imperfect, and in 1859 issued a pamphlet with such information for the Eastern and Australian seas[1] 'to enable officers who have leisure and opportunity to turn their time to best account in aiding to correct the charts'. He mentioned the need for accuracy and the want of additional meridian distances.

The Hydrographer continued to advise on harbour works, harbours of refuge, and similar developments in the Colonies. In 1859 he referred to the use of steam dredgers as being the real cure for our harbour problems, citing the example of the Clyde, the Tyne, the Thames, and Portsmouth in a letter to Sir W. Denison at Sydney. He calculated the dredging quantity and cost (£10 000) for a flat thirty feet deep across the channel into Port Jackson. Washington hoped to live to see Port Jackson visited by the *Great Eastern*, drawing twenty-seven feet—the ship designed by Isambard Brunel, 692 feet in length, twice that of any of her contemporaries, with paddles, screw, six masts, and yards, accommodation for 6 000 passengers or 10 000 troops, and bunkers for 15 000 tons of coal, sufficient for a return voyage to Australia. Launched in 1858 she laid the second Atlantic cable in 1866 but otherwise failed and had an ignominious career as an exhibition ship.

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[1] Bibliography 2, 2.

Advice was given on navigational equipment, such as Walker's log, and there is a note on the first aluminium sextant in 1857, which weighed 1 lb instead of 4¼ lb. In 1856 Washington proclaimed, ' Many know nothing of Greenwich nor is it desirable that they should ', but in 1859 he had to admit that he was obliged to show G.M.T. and local time in hydrographic publications.

In 1855 the Hydrographer made a case for an increase in the salary of the Astronomer Royal, with whom he was in frequent consultation about time-balls and the disturbance that a railway through Greenwich might cause. In 1863, as a result of tidal observations by Calver at the request of the Antiquarian Society, Washington located the place of Caesar's landing in 55 B.C. as westward of Dover.

Recommendations were made to the Board for the award of the Arctic Medal to American and French recipients in 1857, noting in a draft covering letter that it was a medal ' which Her Majesty has caused to be struck as a mark of Her high approbation and recollection of their perilous adventures in the search for Sir J. Franklin '. In December 1858 Washington was able to tell Bullock that the Board had granted him and two of his officers the medal for services in the *Snap* in 1824, in which they rendered aid to the *Griper*, Captain Lyon. The medal of 1857 was for award to all persons of every rank and class in Arctic expeditions between 1818 and 1855. There was another for the *Alert*, *Discovery*, and *Pandora* expedition of 1875–76 and then in 1904 there was the Polar Medal for Scott's expedition and others that were to follow—Hydrographers continuing to advise the Board on the awards.

Washington was one of the original trustees of the Beaufort Testimonial fund and, in the previously quoted letter of December 1860 to Admiral Hope, he took the opportunity to thank him for a donation of £10 and to express gratification that he approved the mode of bestowing the testimonial, since there had been a great diversity of opinion about it. Given for the best examination in navigation and pilotage at the Naval College, the testimonial is detailed in *The Navy List*.

Constantly in Washington's mind was the training of masters and second masters in pilotage, originally of the Channel only; and he wrote in 1859 that the fusion of masters into the Commanders' and Lieutenants' List, and the doing-away with the separate class of masters would do more to benefit the service than any other single measure. In 1862 he was on a committee for the subject, and had to send in a minority report; and in 1863 staff captain and staff commander replaced Master of the Fleet and master, if the latter had sufficient service.[1]

Dawson[2] refers to the effect on Washington's health of the attributing of ship casualties to shortcomings in hydrographic publications. In August 1862, on the grounding of the *Bacchante* in Esquimalt Harbour, Washington said that the omission of a rock was entirely the fault of the department, for which he took responsibility, and he freed Richards, whose survey it was, from any blame. He was able to point out that it was notorious for the kelp to mark rocks on that coast, and if the practice of taking a ship within thirty fathoms of the edge of the kelp continued, masters would assuredly lose their ships. In May 1863 Becher's report, in the absence of the Hydrographer, on the loss of the *Orpheus* on the Manukau River bar in New Zealand, showed from the evidence of the inquiry how a Notice describing changes was held on board, how signals of direction from the pilot station ashore were incompetently given, and how the master had regrettably allowed the ship to run too far in before he brought on the proper leading marks. The need for buoyage had already been agreed, and a new survey was ordered in the following year.

On the loss of the *Genevieve* at Otago, the Hydrographer received, in July 1863, a report of an inquiry held in Mauritius where the board accepted that ' the Admiralty chart was wrong and that the sooner the public was made aware that no such channel exists as the north channel of the hydrographic office, the better '. The Hydrographer consulted the superintendent at Otago, whose answers entirely refuted the statement, and Becher asked that, to save injury to the port, the Board of Trade should publish a correction in *The London Gazette* with a copy to the Mauritius Marine Board, as well as notifying the master of the *Genevieve* of his reckless and mischievous assertion.

Becher wrote of Washington's being unwell in May 1863, and in September of his death at Le Havre on the 16th of that month. Washington was then sixty-three and a rear-admiral. He was a Fellow of the Royal Society (1845) and was one of the original members of the Royal Geographical Society.

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[1] From 1675, the navigators or masters had entered from an apprenticeship at Christ's Hospital and they were qualified and backed by Trinity House. Early in the nineteenth century, masters were given a rank with, but after, lieutenants, and in 1832 the few Masters of the Fleet had commander's rank. In 1843, masters were appointed by commission rather than by warrant, and in 1864 those with fifteen years' service became staff commanders, while Masters of the Fleet became staff captains. In 1867 masters and their juniors became navigating lieutenants, sub-lieutenants, or midshipmen. There could be transfers to the Executive List for meritorious service and special promotion from staff commander to staff captain. Entries to the branch ceased in 1883 and the last staff captain retired in 1913. The lieutenant (N), initiated in 1873, had superseded the master.

[2] *Memoirs of Hydrography*, Part II.

1864–1874

Richards assumed duty as Hydrographer on 14 January 1864. He had wide experience as a surveyor, starting when he was a midshipman in 1835 and including two commissions with the forceful Belcher in the Pacific, 1835–41, and in the Arctic, 1852–54. He had been senior assistant to Stokes on the extensive survey of the New Zealand coasts, 1847–51. He commanded the *Plumper*, and later the *Hecate*, in British Columbia waters from 1856 to 1863. At the Admiralty he found a well-organized office, in which, however, several of the naval assistants were ageing. Thus, within a few days of becoming Hydrographer, he arranged for another, Davis, to join on a temporary basis pending a vacancy.

Throughout the ten years of his appointment during the Victorian era, the emphasis was more on the commercial than the military applications of the contributions that were required from the surveyors afloat and the department ashore; and the only naval expedition to receive mention in the departmental records was that to Abyssinia in 1868. The American Civil War ended in 1865. The Dominion of Canada was formed in 1867, in which year the United States purchased Alaska from Russia. These developments prompted Richards to comment on the need for delineating a water boundary in the North Pacific, and to disagree with the Commander-in-Chief that the survey of British Columbia waters should be broken off even though the colony could no longer afford the £500-per-annum contribution that Richards had himself negotiated when working there. The survey was in fact continued from December 1862, when Richards in the *Hecate* left for home, until 1871, with Pender in charge using a hired vessel. In 1871 British Columbia joined the Dominion, which in the previous year had bought out the Hudson Bay Company. In Europe, Italy and Germany were each achieving national unity, and British sympathy for the Garibaldi movement of 1860 was no doubt demonstrated in 1866 when Richards was directed to assist the Italian Marine by providing its Hydrographer with a description of the organization of the department. By 1870–71 Imperial Germany under Bismarck had asserted her position as a European Power by the Franco-Prussian war. Abroad, hydrographic offices were set up in Germany (1861), Japan (1871), Italy and Sweden (1872), Norway, the Netherlands, and Chile (1874).

The Hydrographer's advice was increasingly sought on naval harbours and their defences, e.g. the Falkland Islands as a coaling-station (1866), the comparative merits of Ascension and St Helena (1869), the defences of Bermuda and Jamaica (1869–70), Simonstown and Trincomalee (1871), and, at home, the construction by convict labour of a refuge harbour at Filey Bay (1871), which would also be of use to the Fleet in defence of the east coast. There was acceptance of the American occupation of Midway Island in 1869. The Swedish annexation of Spitsbergen and the Russian presence in Varanger

Fiord were commented on in 1871 as was also the Italian acquisition of Socotra—' to be regarded with jealousy by this maritime country'. Earlier, in 1864, the Hydrographer, on a Foreign Office reference, remarked on the difficulties of interpreting the international rules on territorial waters. He suggested that one league might be altered to two under the then ' altered conditions of projectiles of war', and he mentioned the historic use of King's Chambers for estuaries or bays. (In later years an assistant was to become known as the Territorial Waters Officer.) Sail had to all intents been superseded by steam; and, by 1870, screw propellers were beginning to replace paddles. There was the steady development of electricity for various purposes, although Richards said in 1871 that the electric bells in the department still performed wildly and without reference to any known law.

The Suez Canal was opened by the Khedive in 1868. In 1870, the Hydrographer and the Director of Engineering and Architectural Works, Admiralty, were sent to examine it, their inspection being made from the *Newport*, in which ship Nares surveyed the Gulf of Suez, hence the name of its prominent rock lighthouse. Their report, which was presented to Parliament, stated that the canal could not take large ironclads or Indian transports, but that an increase of width was feasible, given an undertaking with sufficient finance; and that the decision whether such an undertaking should be national or international was a political one. The next year the importance of the canal to Great Britain and doubts about the ability of the proprietors were expressed; and Nares made a further report. There followed detailed discussions between Richards and Admiral Paris, the French Hydrographer, on Anglo-French responsibility for surveying and lighting the Red Sea; and in 1875 Disraeli purchased canal shares to secure a British majority holding.

British activity continued to be world-wide. In 1869–70 there was the world cruise of the Flying Squadron; and the Remark Book of the flagship *Liverpool* was singled out for praise by the Hydrographer. Surveys continued in Japanese waters, and Richards's contribution to the 1867 address of the President of the Royal Geographical Society, was: ' The labours of the surveyor have always been and always must be the precursor of Commerce. The vast empire of Japan indeed has the outline of its shores fairly represented on our charts upon the authority of its own ingenious geographers and its principal ports, to which we are at present admitted, have been surveyed by ourselves but there is still a void which the annual record of disasters too clearly confirms and which, if ancient custom is adhered to, it will remain for us to fill up.'

In 1865, Richards, ' with the cheerful cooperation of the Chilean Government', sent Mayne in the *Nassau*, a screw ship of 900 tons, to resurvey the Magellan Strait and the passage northwards into the Pacific, ' so much used by shipping of all nations, more especially of our own'. He achieved this by reducing the second Mediterranean survey. Later, the same ship, under Chimmo, had in 1872 to withdraw from the Sulu Sea owing to hostilities between Spain and the Sultan of Sulu; in 1873 she was sent under Gray to survey the east coast of Africa from Delagoa Bay to Guardafui. In his proposal to the Board, Richards said that along this coast the slave-trade was carried on to a greater or lesser degree, and his instructions were that the Commander-in-Chief would consider the ship as ' part of the force for the suppression of the slave-trade but that, unless in case of special emergency, she is not to be diverted from the particular service upon which she has been ordered by Their Lordships '.

Also in 1873, Dawson, who as a sub-lieutenant was recommended by Richards in 1869 for promotion on account of his work in the Yangtze, was sent out to assist Captain Moresby, who in the *Basilisk* during a cruise to stop ' kidnapping ' had explored the coast of New Guinea, sited Port Moresby, and, incidentally, found gold. This gold find, with its attendant possibility of a rush of adventurers, gave Richards cause to advise that his copy of the report should be sent for information to the Foreign and Colonial Offices without waiting for the official document through the Commander-in-Chief. Once again the settlement at Cape York was mentioned as having been set up in 1865 on the (unrealized) prospect of more traffic through Torres Strait; and now a move to Hammond Island was proposed.

Colonial surveys continued, notably on both coasts of Canada and round Australia where half the costs were being paid by the various States. However, when New Zealand proposed surveys on a similar basis, Richards, in agreeing, had to say that her coasts had been covered by the comparatively modern surveys of 1848–55, so that the task was to survey sheltered anchorages and harbours. In 1869 the Board decreed that all costs should be borne by the New Zealand Government, though surveyors would be lent and the results engraved at home. In 1871 the India Office opened discussions for the resumption of the responsibility by India for surveying her own coasts. While refuting charges that the department had been inactive since the transfer of Indian surveys to it in 1861, Richards was sympathetic, given that there was an experienced surveyor as a superintendent in India who would act in concert with the Hydrographer. But the rearrangement was not completed in Richards's period. Aden was resurveyed at India's request in 1870 by an officer sent from England. The Cape-of-Good-Hope survey, begun in 1853, was concluded in 1872.

Oceanographic work was still partly occasioned by the laying of telegraph cables, for which there were many deep-sounding cruises during the period. Notably, there was the diversion of Shortland in the *Hydra* from the Mediterranean to the Indian Ocean and the Atlantic in 1867–68. His blacksmith and two others each received £1 for their ingenuity in constructing a spring for detaching the weight from the line upon its striking the bottom. There was Griffith's machine, and a first reference to a Baillie in 1873. Owing to the American Civil War, the organization of the transatlantic-cable project fell more to England than America, and in 1865 the *Great Eastern*, chartered by the Telegraph Construction & Maintenance Company, and led out of the Thames by the *Porcupine*, made the third attempt, which failed after 1 200 miles. She was, however, successful in 1866, completing a second cable by continuing from the break in the 1865 cable, for which she had successfully grappled. The enthusiastic Field was on board.

Scientific interest in the oceans was on the increase. In 1868 Chimmo in the *Gannet* (a screw ship of 800 tons) investigated the Gulf-stream before running a line of soundings homewards across the Atlantic. Reed took a naturalist, Dr Collingwood, at his own expense, to the *Rifleman* in the China Seas in 1866, but the arrangement was not a success. In the same year Dr Cunningham was formally appointed to the *Nassau* in the Magellan Strait on a proposal of the Director at Kew, specifying botany and marine zoology. Richards obtained Treasury approval for a salary of £200 and for its later continuation so that results could be worked up, quoting the *Fly* and the *Rattlesnake* as precedents. Specimens were to be the property of the Admiralty, and evidently there was considerable competition for their use among interested scientific bodies. By arrangement with the Royal Society, Dr Carpenter[1] was embarked for marine biological work notably in the *Lightning* (1868) and the *Porcupine* (1870), and it was he who in 1871 made the initial proposal to Richards for a world voyage, for which the *Challenger*, a screw ship of some 2 000 tons, was at once suggested. The Royal Society's formal application soon followed, so that early in 1872 Board approval was given and Nares was selected to command, with Professor Wyville Thomson[2] the senior scientist. In close collaboration with the Royal Society, Richards issued instructions in November 1862 and the Board's sailing orders said:

> It is therefore Their Lordships' direction that in all matters connected with the scientific objects of the voyage you are to pay such regard to the wishes and suggestions of Professor Thomson as may be consistent with your instructions and with the safety and well-being of your ship and crew.

The *Challenger* sailed on her famous voyage in December 1872.

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[1] Dr W. B. Carpenter, C.B., F.R.S., was Professor of Physiology at the Royal Institution from 1844 and Registrar at London University from 1856. His work on marine fossils in 1868 was in association with Wyville Thomson, and he contributed to the doctrine of general oceanic circulation. His death in 1885 at the age of seventy-two resulted from a laboratory accident.

His fourth son, P. H. Carpenter, sailed as palaeontologist and zoologist with his father in the *Lightning*, the *Porcupine*, and also the *Shearwater* on a Mediterranean cruise in 1871. He assisted in the working-up of the *Challenger*'s results with a report on crinoids in 1884, but in 1891, when a master at Eton, his life ended tragically at the age of thirty-nine.

[2] Sir Charles Wyville Thomson was the son of a surgeon in the East India Company. After holding various professorships in natural science in Ireland, he became Professor of Natural History at Edinburgh University in 1870. He accompanied Dr Carpenter on the cruises in the *Lightning* and the *Porcupine*. After the *Challenger*'s voyage ended in 1876 Thomson was knighted and appointed Director of the Challenger Expedition Commission to superintend the publication of the results. Ill health overtook him in 1879 and he died in 1882 aged fifty-two.

In home waters, Richards reorganized the surveys in accordance with his view, expressed in a letter to E. J. Bedford in May 1865, that the coasts of the U.K. were then so complete that there was no special portion needing a continuous survey party. He stated that the three principal objects had become to extend soundings out to off-shore features, to cover changes due to physical causes, and to take care of alterations in the pattern of trade and in harbour constructions. By 1865 the parties had been reduced except for that in the Channel Islands, and the tenders *Bann*, *Asp*, *Shamrock*, and others, laid up. The *Porcupine* continued in service and was joined by her sister ship, the *Lightning*, in 1864, both with hired crews and both paddle-driven.

Each year, the Hydrographer planned his ship requirements for the next, and the foregoing review of Richards's period may be concluded by quoting the minutes on his proposals for 1873.

By the First Lord (Goschen) on 25 November 1872:

> I am as much impressed as anyone else with the great importance of the surveying work which is being carried on and the ability with which the service is conducted, makes one naturally wish to give every facility and development to it. But I constantly stand aghast at the enormous proportion of the Expenditure in men and time absorbed by the non-fighting part of the Navy (though surveying vessels are only a small sub-division of the non-fighting class).
>
> I understand that the Hydrographer was anxious to proceed with the survey of the Irish coasts next year. The *Harpy* was to be prepared for this service and the *Alert* for other survey service. If a small steamer could be hired for the survey of the coasts of Ireland in 1873, it appears to me that it would be far preferable to repairing the *Harpy* now when we have much pressing work on hand for new ships.
>
> Non-fighting ships ought only to be taken in hand in preference to fighting ships when it is absolutely necessary. The *Alert* may be proceeded with bye and bye, but if the *Sylvia* should be in a fair state and the *Nassau* can be repaired at Malta, I presume the repairs of the *Alert* can also be deferred for some time.

By Richards:

> My submission of 25th is I think quite in accord with the First Lord's memo of the same date as regards the provision of reliefs for surveying vessels. My anxiety that the surveys should not lapse even for a time was caused by a knowledge of how much the safety of these great iron ships of the present day depend on the labours of the surveying vessels. I would venture to point out also that in all conflicts which have occurred during the last 25 years the surveying vessels have been the Pioneers of the Fighting Fleet—hence the necessity of training officers and men for future contingencies.
>
> The arrangements proposed by the First Lord entirely meet the requirements of the surveying service immediately and prospectively.

Marginal note by Admiral Dacres of the Board:

> The Hydrographer's remarks as to the distinguished part taken by the surveying officers in all our late wars, I gladly endorse and every officer engaged in China, Baltic and Black seas will gladly do likewise.

An Order in Council of November 1865 increased the Hydrographer's salary from £800 to £1 000 in addition to half pay on the grounds of increased duties occasioned by the transfer of the Indian hydrographic work and the increasing requirements of modern science bearing on his department. In the fourth edition of the Admiralty *Manual of Scientific Enquiry*, 1871, the hydrographic section was again revised by the Hydrographer.

Richards brought to the notice of the Board any good work done by surveyors afloat or by officers in the department; and his *Memoir* of 1868, various references to which have already been made, had the object of informing the Board and other Government departments. Its introduction spoke of the department's usefulness after a comparatively short history, and of its being almost unknown outside its own sphere. Any shortcomings had been leniently dealt with, but it could not rest at that, and he [Richards] had always felt that when its present could be regarded with satisfaction, it should with its past, be recorded for the benefit of the future. The enlightened liberality of successive Governments meant that the time had arrived, and he thus offered a sketch of the department to its rulers with the aim of making clear to them what, even to himself, had for long appeared obscure. All the historical details do not fit the official records as Richards relied on his own recollections and on the testimony of some ' until lately living ', but there is a useful record of the department of the day. The *Memoir* was the origin of the often-quoted phrase: A state of war had always proved to be the opportunity of the Hydrographic Department. (Though only a small number was printed for private circulation the Exchequer and Audit Department later said that it should have gone through H.M.S.O. rather than direct to Malby!) One other useful source became available in 1864 when *The Navy List* included a list of surveying officers with their rank, ship, and station. For example, in 1864 there were six captains, ten commanders, six lieutenants, ten staff commanders, twenty-seven masters, eight second masters, and two paymasters; and in 1874 two captains, one commander, seven lieutenants, one sub-lieutenant, twelve staff commanders, fourteen navigating lieutenants and nine navigating sub-lieutenants. Minute-books became more detailed, perhaps owing to increasing bureaucracy, and, fortunately for posterity, were permitted to continue in 1868–69, when correspondence rules were reviewed.

In the office, during his first year, Richards obtained a sixth draughtsman, who had in fact been authorized by the Order in Council of July 1862, the temporary naval assistant previously mentioned, and approval to retain the writer, allowed provisionally to Becher during Washington's last illness. In July 1864 he reinstituted the post of chief draughtsman; and when T. Walker then retired after fifty-four years' service, severing a family connexion that had existed since 1795; Hoskyn succeeded him until June 1865. By that date Powell had sufficient seniority for promotion to replace Hoskyn who took over as Superintendent of Charts from G. A. Bedford, who in turn became Professional Officer at the Board of Trade.

At the end of a year, Richards made a detailed report to the Board, dated 8 December 1864, showing by statistics the increase of work over twenty-five years, ' while the additions to the labourers had only been two, viz. one naval assistant and one draughtsman '. The engraving of new charts from new surveys was satisfactory, largely owing to the able and indefatigable superintendence of Bedford since 1862. Three assistants were fully employed on chronometer issues, now over 900, on the larger Tide Tables containing twenty-four standard ports and H.W. data for 2 000 ports abroad, and on the increased issues of more published charts and corrections, there being 450 chart-boxes in circulation. The two assistants on Sailing Directions were losing ground notwithstanding their utmost exertions, and it was here that the weakness was most exhibited. The state of original documents, now over 30 000, left much to be desired; and this was supported by a report from Davis, who showed how Becher had had to leave much to Nye, messenger, since 1854, and what should now be done. Finally, there was the heavier weight of correspondence. On the other hand, since 1847 £81 000 had been paid into the Treasury for charts and the like sold, which represented nearly one year's expenses of the department. An appendix to the report showed that the staff of the French office was double, though the French Hydrographer had said that their output was not comparable. The report concluded with the comment that the French and Russian Governments preferred to supply themselves from our engravings, and that it was not too much to say that the English make and publish charts and the like, for the whole world, yet our immense commercial connexion with all parts of the globe would not justify any diminution of energy in this respect, for our own sake.

In February 1865, the Treasury approved an increase in staff, so Davis came on the establishment as Curator of Original Documents, McDougall was added for Sailing Directions, and the writer became permanent. There were no other changes except that when Becher's almost continuous forty-three years in the office ended in June 1866 Evans succeeded him as Chief Naval Assistant and secretary of the Board of Visitors, Royal Observatory, and was also ' in charge of the Magnetic Department '. Other retirements, at the age of seventy or over, were Read in 1865, King in 1866, and Dunsterville and Burdwood in 1870. Hoskyn died in 1873 to be succeeded as Superintendent of Charts by Hull who had joined in 1866. Also in 1866, Blackney (later spelt Blakeney) was the first of two paymasters who were for a number of years to handle the administrative matters. In that year the first and junior assistants were styled civil (£600 and £450), and the other five borne on ships' books at full pay, with surveying pay making up salaries to £550–450. In 1870 they all became naval, either on ships' books, in order to maintain their pension prospects, or on the Retired List, their salaries being unchanged. The retiring age was set at sixty-five, and on Richards's insistence the appointments could be for five years and also renewable. It was difficult to recruit draughtsmen through the Civil Service Commission, and Sharbau (1856–73), whose son followed him into the department (1890–1928), had on account of age to be a temporary, but he set a precedent with extra payments for translation work. Burdwood in his leisure time extended his azimuth tables, receiving £140 for the first extension.

The catalogue for 1875 showed 2 619 charts—the demy sizes or smaller had decreased to 480, no sheets of views remained, and the imperial size came into use. The total number of published charts had begun to increase less rapidly (one hundred in ten years) as new work replaced old in cancellations or occasioned more corrections to existing plates. Figures for 1864 (figures for 1860 in parentheses) were: charts engraved 122 (199), plates corrected 521 (136), Hydrographic Notices 125 (14) and Light Notices 159 (139). There were seventy Sailing Directions, books of views, and the like, and, as before, one Tide Table (not accompanied by Burdwood's 1865 directions for reducing them) and ten Light Lists. Noteworthy additions were the Pilot charts of the Atlantic in 1868 followed by a world edition in 1872, giving wind and current information. There were index charts; and in 1866 a comprehensive edition of ' Signs and Abbreviations used on Admiralty Charts '. An Ice chart of the southern hemisphere, published in 1866, was a massive compilation by Evans and McDougall using the voyages of Cook 1772–75, Bellinghausen 1819–21, Weddell 1822–24, Foster 1828–29, Biscoe 1830–32, Balleny 1839, D'Urville 1839, Wilkes 1839, and Ross 1841–43 as well as papers by Towson 1855–59 and from the Meteorological Office of the Board of Trade. It was a fine example of lithography by Malby and had a green land-tint. A printed list of new charts and one of the recipients of presentation copies were submitted annually to the Board. The cartography of the period showed further simplification, especially of the topography. Chart 1182, ' Cardiff and Penarth Roads', 1868, used egyptian print for water features and, being ungraduated, adopted scales of latitude and distance and a minute of longitude. Sloping roman lettering came into use.

When the Walkers retired in about 1866, the engravers became Stanford, Davies Bryer & Co., and Weller, but owing to the particular nature of the work, their number was restricted. An inscription in the bottom-left corner, ' Drawn by H. Sharbau under the direction of Captain Hoskyn ', appeared in 1870, but this practice seemed to cease in 1874. Once again, in 1871, the Hydrographer resisted the use of colour as being unnecessary and too expensive for general adoption. In 1873 Richards had occasion to review the means for avoiding errors on new charts, which caused Powell to criticize Davis's system for the original documents compared with Becher's, to recommend that coloured indexes should be adopted (they were begun some ten years later), and to think that Hoskyn was over-zealous in chart production; and Hoskyn agreed that every document should be indexed before being used.

In 1869 another room and attic were added. A move of the department was mooted in 1865, and in 1872 it was proposed that the coppers should be kept at Greenwich Hospital, but the Board was insistent that the Hydrographer's presence in Whitehall was absolutely necessary at all times, even in peacetime. The duplication of coppers by electrotype was considered but discarded. By 1871 the patent for steeling coppers had been purchased for £300 and was most successful although there was also a drive to reduce wear on plates by limiting the number of charts on the Admiralty shelves and the stock of chart-boxes. In 1865 the disadvantages of outside printing were seriously discussed, but as there was no evidence of fraud, and as there were grounds of lack of space and money, the alternative of the department's having its own establishment was again ruled out. Familiar arguments were used in 1869 on the superiority of copper engraving over photolithography for chart work. The exclusion of H.M.S.O. from chart publication and sales was again raised in 1866–67.

From 1868 to 1873 there were minutes on Potter's sole agency, such a monopoly being objected to by Mr Graves, Member of Parliament for Liverpool. In 1870 there was a general opinion that the sole agent should be eliminated in favour of an Admiralty depot under a Professional Officer, but Richards continued to argue that there would be no benefit to the purchaser. In 1871 an arbitration court decided that Potter's agreement was not for life but should continue until September 1873. At that date a new agreement was in fact concluded with Board approval. As heretofore, discount was to be forty per cent on the retail price; only Admiralty publications were to be sold; subagents were to receive twenty-five to thirty per cent discount and were to promote publicity. There was no mention of hand correction from Notices (outside naval circles), but in 1869, when the Hydrographer discussed arrangements for cancelled charts, he said that the circulation of Notices to agents was in order that those holding them might themselves make the necessary corrections. In no case would the Admiralty be held responsible for the insertion of the information, and subagents were to cease sending charts to the agent for correction. (The allowance of one free chart in twelve to Potter was cancelled in 1865 but the practice reappeared later.) In aid of publicity, copies of new charts were sent for display at custom-houses, Lloyd's, and so on in 1868, and from 1872 bi-monthly lists of new charts published were circulated to all agents. A drop in sales was explained by Richards in 1869 who said that the high figure of £8 000 in 1864 was due to the American Civil War and was nearly the same in 1866 because of the tension between Denmark and Russia. The Secretary, Childers, thought that the reduced takings could mean a decrease in the Estimates; the Board, however, agreed with Richards that no diminution of departmental work was involved. A low sales figure of some £5 000 in 1871 rose again to £8 000 ten years later.

The correction of charts, and the destruction of those cancelled, in the Fleet and in the depots, received renewed attention. The remuneration of masters of flagships and others who handled the stocks at the ports was approved by the Board in 1868 at £15 for Portsmouth and Devonport and

£8 at Sheerness[1] and Woolwich, but it was not considered justified abroad. A new innovation for the Fleet was the issue in 1865 of a selection of charts for each naval station to be used by the officers in wardroom and gunroom messes. They were later to be known as 'Officers' Chart Atlas' folios, and it was said that Bethune had suggested them in 1838. A smaller and improved form of Remark Book was introduced in 1864.

In July 1866, after six months' trial, the Hydrographer accepted the transfer of the Fleet's pilotage transactions to his department from the Accountant-General. Mr Dimsey was transferred with the work as a civil assistant, and, since the Hydrographer had previously often to be consulted, it was a convenient rearrangement. The Hydrographer also undertook to preside over the examination of masters in pilotage in 1869, when the Board ruled that it was to be conducted by naval officers. Thus, after many years, the responsibility of Trinity House ended; Richards had had friendly discussions on the subject with them from 1866, but it was time for a more general knowledge, including the use of charts and Sailing Directions in place of an examination restricted to the Channel, though its importance would not be overlooked.

Compass Department's activity reflected the progress in this field, and in 1868 a navigating lieutenant was added to the staff. Evans produced a number of important papers and *An Elementary Manual on the Deviation of the Compass in Iron Ships* in 1870, when Richards took the opportunity to tell the Board of Evans's international reputation and how navies of all countries as well as our own were indebted to the Compass Department for the published information that existed on the subject. That year the department moved from Woolwich to Deptford. There were trials of equipment such as the gymballing by the Earl of Caithness and the Nunn's light-urns, though the former received adverse reports and the latter were too expensive.

The Hydrographer was heavily engaged with the Astronomer Royal's arrangements, especially in transport and finance, for viewing the sun's eclipse in 1870 at Gibraltar, and even more so for the transit of Venus in 1874. For the latter, there were eighteen observers recruited from the Navy, the Army and the sappers or civilians. They had to be transported with their equipment to Alexandria, Christchurch (New Zealand), Rodriguez, the Sandwich Islands, and Kerguelen, which involved correspondence with the Foreign and Colonial Offices. There were many staff matters at the observatory, and it was with some relief that Richards minuted in 1873 the end of the discussions with the Treasury and the Civil Service Commissioners on appointments other than by open competition. The threat of railway interference was at last resolved when a new proposal was made in 1870 for the line to pass outside Greenwich Park; and in 1868 Richards obtained some entertainment expenses for the

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[1] The naval yard at Deal was closed in 1863—the historic use of The Downs by H.M. Fleets had come to an end with the advent of steam.

Astronomer Royal on the day of the visitation when there might be as many as 250 men of science present.

Some responsibility for the library continued with Hydrographer because it was in an adjacent room and was constantly used by his staff, but Richards was unsuccessful in getting an increase of salary for Mr Thorburn in 1872.

The Hydrographer was consulted on a variety of matters. The siting of lighthouses abroad caused a difference of opinion with the Board of Trade who, in Richards's view, had wrongly interpreted the Harbours Transfer Act and ought not to undermine the Hydrographer's responsibility in this matter. Richards added that their Professional Officer (Bedford) had insufficient authority. Advice was given on harbours, especially those remaining with the Admiralty after the Transfer Act. A full report was made on Dover in 1873, the importance of which for communications with France was stressed, including a mention of train ferries even at that date. There was considerable uneasiness on the slowness with which an agreed plan of breakwater construction was being reached. There were minutes on Channel Tunnel proposals between 1868 and 1870; and again, in 1866, the Hydrographer was consulted on the place of Caesar's landing. Questions on the rule of the road arose, Richards deploring discussion of the rules, so carefully and internationally agreed in 1863, whenever there was a collision. A transfer of the lifeboat service to the Government was opposed in 1866 on the grounds that it was working well on a voluntary basis and that it would be more expensive to have a number of crews on permanent pay. Advice was given in 1868 on Young's expedition in search of Livingstone. Bedford's universal buoyage was disliked, being described as his hobby—seventy years were to pass before there was an international convention on the subject.

In March 1869, Richards wrote a review of the Meteorological Department at the Board of Trade, recalling the international discussions in 1853, including Maury's advocation at Brussels of observations over the oceans. Then, from 1855, there had been Fitzroy's directorship of the department when he actively fostered such observations at sea, though no publication resulted. A few years before his death in 1865 he had switched his attention to issuing storm-warnings based on observations from coastal stations, and on his death the Royal Society with a committee of three, including the Hydrographer, had made a report that resulted in a larger scientific committee of the Society, which appointed and advised a new director. After two years' study, and under pressure of public opinion, rules had been drawn up for forecasting the approach of storms instead of merely passing out the prevailing conditions round the coast. Richards concluded that this organization should continue.

Afloat, the relations between the surveying service and the general service and the future recruitment of surveyors from both the Executive and Navigating Lists exercised Richards's mind considerably. He also pursued the amalgamation of the two lists by proposing in 1867 that the examinations for lieutenant and navigating lieutenant at the Naval College should be assimilated; and in 1873 the Board announced their intention of employing a number of executive officers in navigating duties, subject to their passing the pilotage examination in the Hydrographical Office. Pilotage classes had been held at Portsmouth in a cabin of the flagship until 1837 when, on the opening of the Royal Naval College, Greenwich, use was made of the building in the dockyard which had been the Naval Academy (or College) since 1729 and which was later to become the Navigation School.

In a letter to Mansell dated February 1864, Richards expressed the view that the officer in command of a surveying ship ' should endeavour to show the Admiral on all occasions that he is no way desirous to misconstrue or overstrain the Admiralty Instructions [in *Queen's Regulations and Admiralty Instructions*] as regards non-interference with surveying ships . . . and should consider himself as the professional adviser of the Commander-in-Chief and should meet his wishes and forward his views readily and at all times '. In June the same year, Richards, in a long minute to the Board reviewing the existing arrangements for the surveying service, said: ' For many years past a surveying ship has rarely left England with more than one trained man on board save the Commander, sometimes none, yet in the course of a very few years the whole staff are competent. Some decided measures are now necessary to meet the demand for officers.' After correspondence with Admiral Hope, Richards in December turned down Sulivan's[1] plan for twelve ships of various sizes for all stations doing both man-of-war and survey work; and he abandoned his own plan to appoint a surveying officer to the staff of each commander-in-chief to carry out his particular requirements and to encourage promising officers, coupled with training at home in local vessels or in the *Britannia*. But he agreed to the commissioning of two ships, the *Serpent*, Bullock, on the China Station and the *Gannet*, Chimmo, on the North-America-and-West-Indies Station, principally as men-of-war. He explained to the two commanding officers their position under the Commander-in-Chief and the purpose of training young officers, but there would be opportunities, for taking deep soundings, running meridian distances, and observing for geographical position. By 1866 there were misgivings, and when the commissions ended, the experiment was not repeated, though when the *Gannet* was paid off in 1868, Chimmo's work was considered equal to any sent in by a regular surveying ship.

Richards continued to nominate surveying officers for promotion on the 1863 basis of a commander to captain every other year and a lieutenant to commander and sub-lieutenant to lieutenant every year; he also arranged that navigating officers should be included. In 1869, however, he asked that commanders and lieutenants should no longer have to wait for the Hydrographer's few nominations, which would then apply only to sub-lieutenants and navigating lieutenants. He continued to select officers for command on their particular qualifications whatever their rank. In appointing Gray to the *Nassau* in 1873, he said Gray had lately transferred from the Navigating to the Executive List, was likely to be promoted to commander, and could then retain command of the *Nassau*. In fact, the captains and commanders on surveying markedly decreased through retirements and reorganization, and Dawson refers to naval reductions of 1869.[1] At the end of Richards's period there were one captain (besides Nares in the *Challenger*), one commander, one lieutenant, six staff commanders and three navigating lieutenants, the ships being four—the *Porcupine*, *Shearwater*, *Sylvia*, *Nassau*.

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[1] *Memoirs of Hydrography*, Part II, records Sulivan's contributions in 1858–59 to the improvement of naval officers' training and promotion.

In August 1864 a fourth class of assistant surveyor was introduced at 2*s* 6*d* per diem abroad and two shillings at home, on the grounds that the existing arrangements gave too high a rate of pay after only one year's probation. A list of volunteers was kept in the office, which was preferable to relying on a nomination by a commander-in-chief when there was a vacancy.

From 1864, a circular letter went out with the 'Return of Survey' forms, which were already in force. It required a letter of proceedings in June and December from abroad and three-monthly from home ships. Tracings of the work were to be forwarded before commencing another season and were to be accompanied by information that would enable it to be published, if necessary, without delay. Official letters were to be numbered. Private or semi-official letters were apt to be mislaid, but at the same time, Richards had no desire to deprive himself of information in any form most convenient to the sender. In 1865 a 'memoir' was introduced for the fair sheets, including the type of triangulation, geographical position, sounding-datum, and source of topography; and this has remained the pattern. It was also decreed that too much time should not be spent on the topography or its working-up on the drawings. In 1870 a double-buoy was made for the *Lightning* and may have been the prototype of the Egeria beacon that came later.

The loss in 1867 of the *Osprey*, in which the set of the current was a factor, is one example of a casualty during the period. Richards commented that the ship's issue of Horsburgh's *Directory* rather than the *Africa Pilot* was a deliberate decision, and that no Sailing Directions can prevent disasters. He went on: 'If indeed the late wreck can in any degree be traced to default on the part of the Admiralty, then I can conceive no case of wreck could occur which might not be traced to a similar default and as a consequence from this established precedent, accepted as a valid excuse by a court martial.'

Richards was retired by the regulations and resigned as Hydrographer in January 1874 at the age of fifty-four, having been made a rear-admiral in 1870 and a C.B. in 1871. He was a Fellow of the Royal Society and of the Royal Geographical Society, and had been a member of their councils and a vice-president of the former society. He was knighted in 1877, in which year he became a vice-admiral on the Retired List.

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[1] *Memoirs of Hydrography*, Part II, p. 138.

1874–1884

Evans assumed duty as the Hydrographer on 25 January 1874. His first surveying appointment had been in 1833 as a master's assistant with R. Owen in the *Thunder*, and other notable appointments were to the *Fly* in Australian waters from 1842 to 1846, the *Acheron* on the coasts of New Zealand from 1848 to 1851, and on war service in the Baltic in 1854–55. He was in charge of the Compass Department from 1855 and continued so when made Chief Naval Assistant in 1866. Having been specially promoted to staff captain in 1867 for his contribution to nautical science, he became a captain on the Retired List in 1872.

During the ten years and a half of his appointment, the already established commitments of the Hydrographer, his department, and the surveying service steadily increased. Britain's possessions were growing and her position as a maritime Power involved her in responsibility and activity in many parts of the world. Her route to the East was safeguarded in 1875 by Disraeli's purchase of shares in the Suez Canal, and in 1876 Victoria became Empress of India. The Afghan wars ensued in 1879–81.

In the Far East, the surveys of Japanese waters begun in 1861 continued until 1882. At the request of the Commander-in-Chief, China, the *Sylvia* was transferred to the south-west coast of Korea in 1875, but a hostile reception from the mainland natives was encountered, and it was not until after a treaty of amity and commerce that in 1882 Hoskyn in the *Flying Fish* was able to do effective work in the approaches to Seoul, and to make a valuable report on Korea and its people.

The survey lasted two seasons and it was appropriate that towards the end of British surveys in these waters, Hoskyn should have received a handsome present from the Mikado for rescuing six Japanese officials in a boat off Korea after their legation had been attacked. The present consisted of several works and maps on Korea and a handsome, bronze vase specially made for the occasion and bearing an inscription descriptive of Lieutenant-Commander Hoskyn's services. The propriety of accepting such a present had to be referred to the Lords Commissioners of the Admiralty, who permitted it owing to the difficulty of returning presents to the Mikado. The incident was the subject of a letter to the Hydrographer from the Commander-in-Chief, China, which spoke of Her Majesty's Minister to Japan having improperly diverted the *Flying Fish* from her surveying duties, adding that he had written privately to Sir Harry Parkes and civilly requested him to be good enough not to give directions to any of H.M. ships or make suggestions to him as to the movements of himself or squadron, though he would be happy to receive information from him at all times, which would assist him in acting on his own judgment or carrying out orders from Admiralty. A Foreign Office reference, however, thought that the Minister's request to the *Flying Fish* appeared to be entirely satisfactory and asked that Hoskyn be thanked for his report. On this, Evans made the personal comment: 'Yes, I think Sir H. Parkes was right!'

The scene of activity now shifted southwards to Oceania and, as elsewhere, the greater mobility of steam vessels was shown by the undertaking of widely separated tasks. There were surveys in Malacca Strait; off North Borneo, where, in 1879, the Sultan of Brunei had ceded territory to a British trading company; off New Guinea, following Moresby's annexations of 1872–73; and in the Coral Sea. The last was taken up in 1880 when Queensland was unable to continue her share of the costs of the survey of her coast, which was consequently broken off for four years. The new work recognized the growing importance of the shipping routes to Australia via the Suez Canal, from China, and from the Americas, where the construction of the Panama Canal was decided upon under the chairmanship of de Lesseps in 1879. It is of passing interest that when Krakatoa erupted in August 1883, both the *Magpie* and the *Flying Fish* were ordered to Sunda Strait, telegraph cables being used to convey their orders and to promulgate information to mariners. In fact, the Netherlands Government disclaimed any need for assistance, but Vereker in the *Magpie*, who had witnessed the effects from Borneo, proceeded to the scene and was welcomed by the local authorities. He was able to send in a report of this remarkable event, which was published in the *Proceedings of the Royal Society*.

In Europe during 1877 there was the Russian advance on Constantinople to free the Bulgars from the 'unspeakable Turk'. As it also threatened an unwelcome Russian appearance in the Mediterranean, Beaconsfield exerted pressure by bringing Indian troops to Malta, and in England the attitude of a section of the public was expressed in the doggerel: We don't want to fight but by jingo if we do, we've got the ships, we've got the men, we've got the money too. The Treaty of San Stefano was replaced in 1878 by the Treaty of Berlin at a European congress with Bismarck in the chair, and from which Beaconsfield returned with the cliché 'Peace with honour'. At the same time Britain concluded a separate alliance with Turkey by which she obtained Cyprus; but the alliance was short-lived, and the intended effect of ameliorating the conditions of Turkey's Christian subjects did not materialize. In December 1878, the Hydrographer reported on a visit to Cyprus with the First Lord, and shortly afterwards an officer was sent to survey Famagusta Harbour. In the same month the *Fawn* was diverted from surveys off Zanzibar to the Sea of Marmara, and her captain, Wharton, who had been in the *Shearwater*'s survey of the Dardanelles six years earlier, reported friendly cooperation from the Turks.

The Hydrographer also visited Alexandria, long frequented by the Fleet, and in 1882 to be the scene of a bombardment when Britain, alone, acted in support of the Khedive to suppress the Arab revolt, the issue being decided at Tell el Kebir by troops under Wolseley. The tragic loss of Gordon at

Khartoum followed in 1885, before Baring, the Consul-General in Egypt, and to all intents Governor, had mustered sufficient strength to quell the Mahdi and pacify the Sudan as well as Egypt.

In Central Africa, trade was following exploration with the formation of British chartered companies such as in Nigeria where Field was sent in 1881 to survey river mouths in the Bight of Benin at the request, and with the assistance, of the British & African Steam Navigation Company. In 1884 Pullen was sent out as senior member of the Assinie Boundary Commission.

Further south there were the Zulu wars of 1879 in support of the Boers, who had trekked up from the Cape forty years earlier, and in 1881 the Boer defeat of the British at Majuba Hill, Gladstone subsequently granting Transvaal independence. In 1879 H.M.S. *Swallow* had been ordered up the west coast to assist some trekked Boers in difficulties northward of Walfisch Bay and, while unsuccessful in finding any landing-place, she returned with useful hydrographic information. More fateful for the future was the development at Angra Pequena, later known as Lüderitz. The Hydrographer told the Colonial Office, on request, in January 1884 that it had been taken possession of in 1796 by Captain Alexander of H.M.S. *Star*. Prince Bismarck's speech referring to it was quoted in the British press and the Commander-in-Chief, the Cape, reported that on 19 August 1884 the Germans had hoisted their flag with a 21-gun salute at an annexation ceremony. The sequel in 1885 was the carrying of the Anglo-German Boundary Commission to the scene by Aldrich in the *Sylvia*; and later developments in Africa are discussed in Chapter 2.

Other surveying activity in foreign waters included further work in the Magellan Strait, 1878–83, and in the Red Sea, 1882, where Aldrich in the *Fawn* met armed Arabs at Mocha. He was informed that ' his zeal had got the better part of his discretion ', and was instructed to avoid landing in future; as a result the Turkish authorities asked to be informed of British ships' activities in future.

Colonial surveys continued in the West Indies, Newfoundland, and Australasia, much of the surveying in schooners such as the *Meda* and the *Lark* built in England. Archdeacon sailed out the former in 1880 to continue the jointly financed Western Australian survey, which worked in the islands from 1883, having been intended for Queensland where, on resumption of the survey in 1885, a colonial gunboat was used. Surveys of Victoria and South Australia were concluded in 1878 and 1880. Tasmania proposed a survey on shared costs in 1881, but two years later it was agreed not to be an urgent necessity.

In Newfoundland, Maxwell took advantage of an offer in 1880 by the Hudson Bay Company to detach Boulton for a northward voyage in one of their ships to Fort Chimo. In Canada, Parliament attained authority by the British North America Act of 1867 over certain navigational matters. Accordingly there were no further coastal surveys using Imperial funds. For a survey of Georgian Bay in Lake Huron, Boulton was lent in 1883 to the Ministry of Marine and Fisheries, copying his reports to the Hydrographer so that they were included in Admiralty Surveys.

In India it was agreed during 1874 that an organization should be set up at Calcutta for prosecuting coastal surveys with a Superintendent of Marine Surveys (A. D. Taylor, late Indian Navy) under the Indian Government. The Hydrographer offered certain advice and facilities, releasing Carrington from the office to act as head draughtsman; but two years later he resisted proposals for a chart depot at Calcutta, saying it was an attempt to set up an Indian department with imperial functions. Local subagencies and their stocks were, however, improved, and correctional arrangements were made at Calcutta. Other troubles in the organization, including the position of the naval officers on loan, caused the Indian Government to make a searching review in 1880, which resulted in the appointment of a Director of Indian Marine and an officer in charge of surveys in 1882, who was initially Commander L. S. Dawson. When Carpenter, who succeeded him in 1884, wrote his administrative report for that year,[1] he did it from H.M.I.M.S. *Investigator* based on Bombay. The report spoke of a similar status to all other of Her Majesty's naval surveys and referred to the office at Bombay as merely for the storage and correction of charts. It showed that much attention was given to marine sciences, and commented that both Carpenter and Channer had been with the *Challenger* expedition.

The *Challenger* expedition was successfully concluded in 1876, Evans reporting its achievements to the Board in July, and drafting a letter of appreciation from the Board to the officers concerned, the final paragraph of which mentioned with satisfaction that the ship had never touched ground.[2] Evans was concerned for several years with the publication of the results in association with Professor Thomson, who was particularly appreciative of Tizard's nautical contribution. Scientific work with Thomson and the Royal Society was continued when the *Knight Errant* was detached in 1880 for some work in the Faeroe Channel.

Another British expedition to the Arctic was announced by Disraeli in 1874 after some years of pressure from scientific societies, supported by the public. In October, Evans outlined to the Board the scientific advantages that would accrue, referring to the work of other countries, though none had been nearer the Pole than Parry in 1827. The voyage of the *Alert* and the *Discovery* resulted in 1875–76 under the command of Nares, who was accordingly relieved in the *Challenger* before the end of her cruise. The approach to the Pole was to be by Smith Sound. Besides the scientific objectives there was the prestige value in reaching as far north as possible, which in some circles was thought to be incompatible.

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[1] Admiralty Surveys, Bibliography 2, 2.

[2] This seems an odd comment, but characteristic of Evans.

The Hydrographer also gave assistance to the expedition of Captain Allen Young who was accompanied by Pirie in the yacht *Pandora*, 1876, and described such help as a labour of love. (This was the *Pandora* that, renamed *Jeanette*, was used by the ill-fated American expedition under de Long in 1879–81. The ship broke up after a deep penetration from Bering Strait, wreckage drifting to southern Greenland, information used by Nansen in 1893.) He reviewed the Arctic expeditions of the nineteenth century for the Board in December 1881. In 1882 Leigh Smith's party, beset in the *Eira*, were rescued by Young's expedition in the *Hope*, organized by the Royal Geographical Society, with Richards and Nares on the committee. In a minute of April 1880 Evans described to the Board the finding of Kellett's *Resolute* by an American vessel in 1855, a year after her abandonment, and her return to England for restoration to the Queen and people of Great Britain as an offering of good will; and she was visited by the Royal Family at Cowes.

At the fiftieth anniversary of the British Association for the Advancement of Science in 1881 there was a paper prepared by Evans entitled 'Oceanic or Maritime Discovery, Exploration and Research in the Half Century'. It covered Antarctic exploration, mentioning Biscoe, Weddell, Kemp, Balleny, D'Urville, Wilkes, and James Ross; marine surveys, mentioning the U.S. Coast Surveys and new hydrographic departments in Chile (1874) and Brazil (1876); longitude determination using the telegraph; expeditions such as those of the *Challenger*, the German *Gazelle* and the Norwegian *Voringen*; and meteorology, tides, and magnetism.

Internationally the exchange of hydrographic information prospered, other newly constituted hydrographic offices being the Argentinian (1879) and Canadian (1883). This was one of several reasons for the Hydrographer's recommendation that a German proposal of April 1874 for international cooperation in surveying and hydrography should be considered inexpedient. He noted that danger of overlapping was minimized when British ships in foreign waters reported the presence of ships of other countries. In response to a similar suggestion from the same source concerning the polar regions, the Board thought that further examination and assessment of costs was necessary before the Royal Society and other bodies were consulted. More attention was directed to depths of the Pacific, the United States Hydrographic Office being asked for information in 1874 and the Commander-in-Chief, Pacific, being sent equipment in 1877. There were also proposals for a cable between British Columbia and Japan in 1881, for which the Board could not promise the Canadian authorities more help beyond information on soundings.

A major addition to the sources of information were the Hydrographer's annual reports to Parliament starting in 1879,[1] although similar information had previously been published in the Royal Geographical Society's journals. The departmental minute-books, with marginal entries by the Board, were yet more detailed and inexhaustible in their content. The number of pages filled in two months rose from 64 in 1871 to 151 in 1882, as noted in another valuable record, that of the 1883 committee on the department.

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[1] Bibliography 2, 3.

This committee of the Hydrographer and representatives of the Secretary and Accountant-General was convened by the Board in November 1882, and its report of March 1883 discussed the department's activities and organization in detail. Recommendations on the staff (maximum salaries) were: Hydrographer (£1 000+half pay); title of Chief Naval Assistant (Pender who took over from Evans when the latter became Hydrographer) to revert to Assistant Hydrographer (£800); of the seven naval assistants (£550), the senior (J. C. Richards) to receive £50 in charge of Sailing Directions, and another to be styled Surveying Officer for Special Business to take care of the increasing amount of foreign defence information being confidentially recorded (other naval assistants were three on Sailing Directions, one on Tide Tables and Notices to Mariners, and another on chart issues and Light Lists); the civil assistant for pilotage (£600) to help with accounts and be assisted by one or two clerks (£280), which were added for the secretarial business under the Chief Civil Assistant (£650); the title 'Surveying' Officer in charge of Chart Branch (£700) to be adopted since all naval assistants were not necessarily surveyors; draughtsmen to be one chief (£500) and six unclassified (£400), one of them (Gibson) to receive £25 for the care of original documents.

The report recommended that naval assistants should be initially appointed from the Active List and be borne on ships' books in order to ensure their retired pay. It showed that the Hydrographer could spend £365 per annum on the outside revision of Sailing Directions, and that draughtsmen at the engravers were preparing chart drawings that did not require office compilation. The committee thought that the working power of the department was near its limit, but would be kept intact for some years by its proposals. Space was a limiting factor, and in the new building the Hydrographer should be accommodated near to Military Branch. (Evans discussed the space required and the difficulties of any sub-division of it in a minute of July 1883.) The Treasury approved the report in October 1883, being faced with a nett salary increase of only £524 per annum in a total of around £10 000, whereas the sales of charts and books had risen from £4 550 and £283 in 1871–72 to £7 400 and £606 in 1881–82. In twenty years the number of assistants had risen from seven to ten and draughtsmen from six to seven (apart from the pilotage assistant); and there were now two clerks.

The employment of a seventh naval assistant had been allowed in 1875 when, on the retirement of a writer, Paymaster G. W. Underhill was appointed. In 1882 he succeeded Blakeney, who had become the first Chief Civil Assistant in December 1880, and had been given certain signing-powers in order to relieve the Hydrographer. Among other changes, there was in 1879 the supersession of Hull, then Superintendent of Charts. He had read a paper—*The Unsurveyed World*—at the United Services Institution in 1875, which criticized Admiralty administration. There were other incidents and he originated some public criticism of Evans and his predecessor when, in 1879, a paper—*Hydrography Past and Present*—was read by Lieutenant Temple at the British Association's Geographical Section, and its President, Clements Markham, became involved.[1]

Stanley succeeded Hull as officer in charge of Chart Branch, Tizard and Maxwell also being considered. Besides the change of title, there was in future to be the Hydrographer's direction in writing on the use to be made of each incoming item, the forerunner of the department's book *Chart Work approved by Hydrographer*, which dates back to 1889. Davis, who had become a retired captain in 1870, resigned in November 1876 when there were no advancement prospects in the office. He had served for twelve years, during which time he had extended Burdwood's *Sun's True Bearing Tables;* he died two months later having, like Blakeney and others before him, given unsparing service to the department. Dawson was a naval assistant from 1876 to 1881. H. H. Underhill, son of the Chief Civil Assistant and to be one of the first chief cartographers in 1909, was a successful draughtsman candidate in 1884, and in the same year W. D. Barber, who was to be Chief Civil Assistant in 1908, entered as a clerk. Pender, the Assistant Hydrographer, having joined the department in 1871, became a retired captain in 1884.

The 1885 catalogue contained 2 683 charts, an accretion of sixty-four in ten years, notably of Australasian waters; and, since the number of new charts published was eighty in 1875 and from fifty to sixty in 1880 onwards, the replacement of old material was continued at a high rate. In 1880, 2 500 plates received corrections at the engravers; 248 Notices to Mariners (100 more than in 1870) and forty-six Hydrographic Notices were issued, 1 500 and 750 copies respectively being distributed to home ports, commanders-in-chief abroad, colonial authorities, and British consuls, so that they would be ' within reach of all interested '. From 1880, Notices were numbered on single sheets, quoted magnetic bearings and charts affected, and carried a note enjoining correction in red of charts and books as laid down in Admiralty Instructions. The annual report for 1879 said that a number of charts had been extensively corrected and that advertisement of them was made in Notices to Mariners. They were to become known as ' large corrections '.

There were over fifty books of Sailing Directions, many being new editions; the volume of Tide Tables contained more information, including tidal-stream data for home waters; and the Light Lists were still in ten volumes, although the number of lights at nearly 5 000 had more than doubled in twenty years. Two new productions were: *Table of shortest Distances between Principal Ports*, 1879, and *List of Time Signals*, 1881.

Incoming information from the Fleet was fostered by the introduction in 1875 of a printed form—'Hydrographical Note'—and, as acknowledged in the annual reports, there was an effective flow from telegraph-cable companies, home and colonial harbour authorities, and the mercantile marine. From 1879, exchanges of new charts, and those having large corrections, took place with the U.S. Hydrographic Office on their publication rather than on an annual basis. Cartographic developments included references *in situ* to larger-scale charts, a more closely subdivided graduation, sketches of lighthouses and seamarks in more profusion, and position-circles in the base of a buoy symbol. A natural scale was more often quoted, having been first used in Washington's day.

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[1] Appendix C, 4 (Misc. 5, 13).

Sales arrangements and the availability of correct charts to the mercantile marine were constantly under discussion with the Treasury, H.M.S.O., and the Board of Trade. In response to a parliamentary question in 1879, and also to similar questions in 1881 and 1883–84, Evans reiterated his predecessor's opinion that the sole-agency organization was satisfactory, and that the use of Admiralty charts could not be made compulsory. Private publishers' charts were more attractive by being less numerous, although individually Admiralty charts were less expensive; the former were usually a compilation, and any question of the piracy of Admiralty data was a legal matter. Arrangements were made for charts at Potter's to be corrected when necessary by the printer, Malby, and more copies of Notices were supplied for the agents.

Proposals in 1877 to increase the prices of Light Lists and Tide Tables, and in 1881 to charge for lengthy Notices, were resisted since it would adversely affect their use by seamen. The concern of the Marine Department of the Board of Trade about the responsibility of master or owner for keeping correct charts on board, the issue of warnings on this need through local Marine Boards, and the fostering of local correctional arrangements on a repayment basis (such as those set up privately by Hull in London and Liverpool in 1882), were outlined in a memorandum of August 1882.[1]

When J. D. Potter died in September 1882 the agreement was temporarily continued with the firm, pending further discussions in which Evans made a ' luminous ' and successful defence of the sole agency with subagents as being the best organization that could be devised. The Board approved a new agreement with Septimus Potter, but it was not signed until Wharton's time.

Meanwhile, the Hydrographer agreed in June 1882 that the sale of charts at custom-houses could be discontinued. Receipts from chart sales in 1871–72 and 1881–82 have been quoted. In 1873 the number sold passed the 100 000 mark, and in a report of April 1874 the Hydrographer referred to inexplicably large purchases in three months of that year, viz. Italy 3 400, Russia 5 000, and Germany (Berlin) 4 150. Chart-boxes on issue to the Fleet continued to number around 400 with some 300 charts in each box.

The expenses of the department, according to the 1879–80 Estimates, were £8 895 for salaries, £6 000 for drawing and engraving, £5 000 for printing and mounting, and £1 000 for instruments, chart-boxes, and so forth, giving a total of nearly £21 000. The value of charts sold was shown for six years, varying between £5 600 and £6 600, with their number between 100 000 and 120 000. Afloat, the hire of vessels, boats, and the like was £16 328; surveying pay at home £1 389, and abroad £8 232. Under the same heading was £56 192 for pay, victuals, stores, and so on from other Votes, giving a total of £82 141. The Vote 5, Scientific Branch, continued also to show the observatories, the Nautical Almanac Office, chronometers including Portsmouth Observatory (£1 382), compasses (£1 992), the Royal Naval College, schools, and museums.

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[1] Appendix C, 5.

Examinations in pilotage held in the department under the Hydrographer's direction increased from 1883, when every executive officer entered after December 1875 was required to pass. In order to assist them, lectures were given at Portsmouth in a cabin of the flagship, and later ashore—the forerunner of the 'Nav. House'; and in March 1880 there was a printed syllabus with examples of questions. Naval assistants lectured at Greenwich College. The 1883 committee appreciated these increasing commitments in the department and also arranged that the pilotage claims handled by Dimsey should be independently checked by one of the new clerks. The continuing need for a corps of Channel Island pilots to serve the Fleet received attention. There was difficulty in relieving specially trained naval officers by local men who did not know the whole group, but as the Hydrographer pointed out, there were now good charts.

In May 1883 the Hydrographer was asked to comment on a report by four senior officers concerning navigation and pilotage in the Fleet. He thought the classes at Portsmouth, then about twenty strong, were good, and preferable to instruction of individual officers in ships, and that some falling-off in numbers of volunteers for navigation since the 1873 Admiralty Order on specialist(N) officers was due in part to some uncertainty about the future. He said that the surveying service was too small to meet the needs of the Fleet, but, as ever, would provide experts when specially required.

The Compass Department had to keep pace with the greater use of iron and electricity in ships. Mayes was specially promoted to staff captain in 1876 and his responsibilities were again described in a minute of January 1881. Various papers were written by Creak, now a staff commander—one in 1875 on the effect of iron masts, another in 1883 on deviation in iron ships, which was sent to the Royal Society, and a third in 1884 on electric lighting and dynamo effects. There was a protracted discussion on the comparative merits of the Admiralty liquid compass and the compass of Sir William Thomson,[1] who seemed to use personal influence to have trials in H.M. ships without Admiralty authority. In 1883, contrary to Evans's views, the Board decided to introduce the Thomson compass into the Fleet, but ships were still to be steered by the Admiralty compass; a year later it was shown that the latter was better in torpedo-boats, now coming into service. Every new ship was visited, tables of deviation were prepared and revised, and new equipment was tested at Deptford, whence Brunton was pensioned at the age of eighty in 1883 after nearly forty years in charge of the observatory.

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[1] William Thomson, physicist and engineer, also made the first tide-predicting machine in 1873 with the assistance of E. Roberts, and the revolutionary sounding-machine mentioned on pp. 107 and 130. He became Lord Kelvin and formed the firm of Kelvin and White in 1900. He died in 1907, and in 1913 the firm became Kelvin, Bottomley, and Baird, which, under stress of war conditions in 1941, joined forces with Henry Hughes, resulting in 1947 in their amalgamation, to become Kelvin and Hughes.

Royal Observatory matters engaged much of the Hydrographer's attention. The results of the 1874 transit-of-Venus expeditions were finally reported to the Board in 1877. In 1880 the Astronomer Royal made proposals for the 1882 transit, and in 1883 for observations of the sun's eclipse from the South Pacific.

The determination of the longitude of the Cape Observatory using telegraphic signals was sanctioned by the Treasury in October 1880. The time-ball service was extended at home and overseas. There was a chronometer depot at Portsmouth, to which Navigating Lieutenant Swainson was appointed vice a naval instructor in 1874, and which was maintained in face of pressure from the Commander-in-Chief, who had eyes on the accommodation for a pilotage lecture-room. There was another depot at Devonport and, from 1879, one at Colaba Observatory near Bombay. The issue of deck-watches increased, having been begun, according to a minute of March 1883, in 1861 as replacements for cumbersome chronometers. In 1883 the Astronomer Royal attended a meeting at Rome of the International Association of Geodesy on the prime meridian, and, in 1884, it was approved for the Astronomer Royal and the Hydrographer to be delegates at future meetings.

In 1882–83 there was a proposal, to be repeated in later years, that the maintenance of the Royal Greenwich and Cape Observatories should be a charge to the Civil Estimates, and the point was made by the Astronomer Royal that the observatories at Kew and Edinburgh were not comparable, the former being based on private funds and the latter on the university.

The Chief Civil Assistant continued to act as secretary to the Board of Visitors; and on a lighter note, the Hydrographer had to inform a Mrs Balfour in 1875 that ' the Astronomer Royal has hitherto declined to receive ladies owing to the interruption it would occasion to the work of the observatory '.

Maritime meteorology was of concern to Evans, who had been active in the field when Chief Naval Assistant to Richards. He asked Nolloth to attend a conference in London in 1874, which was in continuation of those held at Brussels, 1853, and Vienna, 1873. Evans was able to demonstrate how this country had played a full part; and he reviewed past history in a minute of 28 March 1876, when there was a Treasury committee into the working of the Meteorological Department of the Board of Trade. He showed that the Hydrographic Department had, between 1865 and 1872, produced Ice, Wind and Current charts of the oceans, originally photographed and then engraved, in order to make the information more conveniently available to mariners, and because Fitzroy had neither the time nor the opportunity to do it. Monthly charts were now needed.

In 1876 there was a proposal that the department should take over ocean meteorology, but Evans pointed out the difficulties, including lack of space and staff; and he suggested the alternative of one additional assistant as liaison officer. The Treasury rejected this suggestion saying that the Hydrographer would be an *ex officio* member of a newly reconstituted Meteorological Council.

In 1877 Evans advised the council to use graphic methods of recording data, but in 1878 ran into some personal difficulties with the officers of the council. In 1882 he assisted with the arrangement for observations from the Fleet to further the preparation of daily maps and forecasts.

The Hydrographer was the Admiralty member of a committee with Trinity House and the Board of Trade on revisions to the rule of the road at sea in 1877 and at the end of the year sought the Board's approval of their proposals. Agreement with foreign countries followed, with the result that in August 1879 the changes were published in *The London Gazette* and other publications.

In 1874–75 a War Office request for information on where invading troops might land on the coasts of the British Isles was answered with a series of charts marked up with details, largely provided, at the Hydrographer's instigation, by the coastguard. There was another request in 1877 from the War Office that our fortifications should not be charted, to which the reply, valid in later years, was that for navigational reasons they should be shown, but in outline only.

Comments were made on harbour constructions and their navigational effects, such as the Forth (1878–82) and Tay (1879–80) Bridges, the latter collapsing in the December storm of 1879 and being replaced in 1887. Relevant parliamentary Bills were discussed in association with the Board of Trade and from 1881 the Treasury Solicitor. The Harbours-of-Refuge Commission continued to consider the merits of Filey Bay, but the Hydrographer said in 1884 that Dover Harbour would require all the available convict labour for many years. It was, however, to be another ten years before the Admiralty scheme for Dover's outer harbour was announced.

Various information was given to the Defence Committee on naval stations abroad for coaling and the like; to the Foreign and Colonial Offices on the use of Thursday Island for a settlement instead of Cape York (1875); on the advantages of possessing parts of New Guinea (1876), North Borneo (1879), and certain Pacific islands (1878–83), having the future Panama Canal in mind; on the best site for the capital of Fiji (1871); and on the termination of the Canadian Pacific Railway in British Columbia (1876). The Channel Tunnel and its borings received attention in 1882. When the Director of Naval Construction referred to an Admiralty knot of 6 080 feet in 1883, the Hydrographer drew his attention to Harbord's 1883 *Glossary of Navigation* on this somewhat controversial point, its reference being to a ' mile geographical or nautical '.

Afloat, in a period when the average figures for the Navy Vote and manpower continued to be comparatively low (£11·5 million and 46 000 against £18·7 million and 55 000 in 1890), there were some fifty officers employed on surveying duties. In a letter of 1874, presumably with reference to changing types of warships and armaments, Evans wrote: ' In the part transition state of our Navy, we are left with scarcely an available vessel and it is next to impossible to get a surveying ship.' In November 1880 he appealed to the Board for an extra vessel, showing how the costs of overseas surveys had dropped since the completion of all but one of the Australian State surveys; and he stressed the need for work in the Eastern Archipelago, south-west America, the central Pacific islands, and the Mediterranean coasts of Asia Minor. Admiral Keys gave him strong support, but Lord Northbrook was ' sorry that the claims of other branches ' prevented him ' from increasing the provision for surveys as proposed by Hydrographer '.

In 1876 the following personnel were in charge of surveys: one captain, two commanders, and ten staff commanders (three at home and seven, alternatively lieutenants, in the Colonies). In 1882 there were two captains, one commander, one lieutenant and commander (the new rank), one lieutenant and seven staff commanders (five in the Colonies), plus one commander in India.

Regarding volunteers for surveying, the Hydrographer told the Board in 1883 that there had been a sufficient choice but there was now a falling-off owing to the advent of torpedo officers with specialist pay and the gradual extinction of the old navigating class. He asked, as he had in 1875, that there should be a call for volunteers from acting sub-lieutenants with first- or second-class pass marks at the Royal Naval College. Promotions were hard to come by. In 1880 Evans wrote to St John on the difficulty of bringing forward the young and zealous while giving fair treatment to more senior officers. Nares's recommendation in 1875 for Tizard's promotion to staff captain was deferred while the future of navigating officers was under consideration—Tizard had in fact to wait fourteen years! In the same year Gray was recommended by the Hydrographer for promotion to commander. Two years earlier he had been transferred from master to lieutenant in recognition of a successful resistance to an armed Malay attack on his boat's crew from the *Nassau* in the Sulu Sea. Now, in command of the same ship off East Africa, he contracted fever and died three weeks before the date, 31 December, approved for his promotion. Two future Hydrographers, Field and Purey-Cust, volunteered for surveying in 1875 and 1880 respectively.

In home waters, hired crews were still used for the *Porcupine*, the principal ship, and the *Knight Errant* (not always both in service), and for occasional coastal parties. In May 1882 the newly built *Triton*, a paddle-steamer of 410 tons similar to the *Porcupine* which she replaced, was commissioned as a man-of-war by Tizard. She was to survey for twenty years before being used as a cadet-training vessel.[1] In the Colonies, schooners such as the *Meda* and the *Lark* were in service. On foreign surveys, four ships were usually in commission, and among them were the *Nassau*, *Sylvia*, *Fawn*, *Alert*, *Magpie*, *Flying Fish*, and *Myrmidon*.

General Instructions for Hydrographic Surveyors[2] was revised by Evans in 1877, with editorial improvements. A section on the title and memoir of a survey was added to cover his predecessor's memorandum on the subject. The use of colour on fair drawings was authorized to save the draughtsman's time, e.g. red buildings, yellow sand, brown rocks, grey mud and green land. The value of no-bottom soundings was again emphasized, and the use of deep-sea thermometers included. Appendices were added on the nature of ocean bottoms, tidal observations as ordered for the *Challenger*'s cruise, the treatment of chronometers, secondary meridians, abbreviations used on charts, and the Trinity House system of lighting and buoyage.

Two works on surveying appeared in 1872—*Nautical Surveying* by Laughton, an instructor at Greenwich College, and *Practical Nautical Surveying* by Hull. These were followed in 1874 by Mayne's *Practical Notes on Marine Surveying and Nautical Astronomy*.[3] But in 1882, the officially adopted successor to Belcher's work of 1835 was Wharton's *Hydrographical Surveying*. Mayne's approach to the subject was essentially practical and concise, although he showed his background as a master by devoting the first half of the book to chronometers, astronomical observations, and compass corrections. However, he discussed clearly the need for close sounding, made more practicable with the advent of steamboats, and he showed how easy it was to miss a pinnacle rock. He added: 'It is a very mistaken feeling among young surveyors to despise sounding; that it is not so pleasant as triangulating is granted, but many of those who underrate it are not able to do it properly.' Wharton's manual is referred to in the chapter on his period as Hydrographer, but it may be mentioned here that it described the earliest form of ship sounding by a steam winch heaving the lead from the foreyard-arm; and it gave details of the Brooke, Hydra, and Baillie deep-sea sounding-rods.

There were trials of various new items of equipment and some important advances. A Baillie sounding-machine, an improvement on that used in the *Hydra* and the *Challenger*, did successful trials in 1874; and Navigating Lieutenant Baillie received thirty guineas in 1875 for his disengaging sinkers. Siemens's bathometer, which used differences of gravity, was tried in the *Fawn* in 1876 but did not come up to expectations. In 1884 Evans dismissed, somewhat peremptorily, an invention by Temple Humphreys for taking sounding by submarine sounds, but the records contain no details. Reversing thermometers by Negretti and Zambra proved satisfactory in 1876. Thomson's sounding-machine, which used piano-wire and chemical tubes, and which permitted sounding under way, had protracted trials in the Fleet from 1876 to 1883 when it was gradually introduced. Evans in 1878 put the cautious view that ships should not be encouraged to proceed at speed in fog, and to the end preferred Massey's machine, in service for more than a quarter of a century, comprising a lead that registered the depth of water descended through by wheel-work set in motion by a fly, and its use necessitated taking the way off the ship.

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[1] After lying in West India Docks from 1919 to 1961, she was towed to the Continent for breaking up; her composite hull of iron and wood, copper-sheathed, was still sound.

[2] Bibliography 2, 4.

[3] Bibliography 2, 5.

Walker's taffrail log was given trials in 1884, and in company with similar makes was to supersede the old harpoon logs, in which the rotator with the wheel-work and dials made one assembly and had to be hauled aboard for each reading.

Lastly, for the surveying service, there was the first model of the Lucas sounding-machine, given a trial by Nares in the *Alert* during 1878–79. It measured up to the recommendations of Richards, Evans's predecessor, who was then managing director of the manufacturers (the Telegraph Construction & Maintenance Company). At the time of writing it is still in use.

Evans used the present-day title of Hydrographer of the Navy in the first annual report to Parliament for 1879, made in January 1881. Subsequent reports used ' of the Admiralty ' until Purey-Cust's report for 1912 established ' of the Navy '. Evans congratulated Wharton on his nomination as his successor in January 1884 and, before retiring from the post in August at the age of 79, he took the opportunity of telling the Board of his high opinion of Tizard. Evans was elected a Fellow of the Royal Society in 1862 and served on its council. He was made a K.C.B. in 1881. Writing in 1885 of Evans's death, Wharton said that Evans never recovered from the effects of his visit to America in 1884 for the Prime Meridian Conference, when he overtaxed his already failing strength.

Supplementary biographies

AFLOAT

Kerr, Langdon, H. J. Stanley, Gowlland,
G. Stanley, Ellis, Moresby, Millard,
Napier, Bower, Jarrad

ASHORE

Blakeney, Sharbau

When, in the late nineteen-forties, Rear-Admiral Jackson took up the task of continuing *Memoirs of Hydrography* he followed Dawson's scheme of giving in the period of each Hydrographer some biographical notes of surveying officers who were in charge of surveys and who came to the end of their service afloat during the period. This scheme has been followed and the biographical notes in Jackson's draft up to 1932 have been used. Numerous officers continued their service ashore in the Hydrographic Department as the notes show. Additions have been made in order to include officers, both naval and civilian, who filled senior posts in the department. They will be found in the period of the Hydrographer under whom their service was completed, unless, as naval officers, they had completed service afloat in charge of survey under an earlier Hydrographer. If an officer subsequently became Hydrographer, his complete biography is given at the beginning of the chapter devoted to his period.

Jackson found that the officers listed above had been omitted by Dawson, thus biographical notes of them and of Blakeney and Sharbau are given here.

STAFF COMMANDER J. H. KERR, R.N.

1864–1877

James Hooper Kerr began surveying in 1847, and was in the *Volage*, Graves, for three years in the Mediterranean. In 1851 he went to New Zealand and for over five years was in the *Pandora*, Drury. He became a master and returned to England in 1856. After a short period in Scotland under Wood, he served for six years in the *Actaeon*, Bate and J. Ward, in China and Japan. He returned to England in 1862, and after nearly two years on Scottish surveys, he joined the Newfoundland survey where, in November 1864, he succeeded Orlebar in charge. Nearly eight years later, Kerr was transferred to the west-coast-of-England survey, having been made a staff commander in 1867. He remained in charge of this survey until his death in August 1877.

CAPTAIN C. H. C. LANGDON, R.N.

1866–1872

Charles Henry Clarke Langdon served as second master on the survey of Bermuda under Pullen from 1863 to 1865 and took charge of this survey from 1866 to 1868, having been promoted to master in 1867. In 1869 he was in charge of surveys on the west coast of Africa and examined the mouths of various rivers in the Niger delta. In 1872 he joined the *Shearwater*, Wharton, for three years' surveying in the Mediterranean and from 1875 to 1882 he served in the west-coast-of-England survey under the successive commands of Kerr, G. Stanley, and Tizard.

Langdon became a staff commander in 1878 and in January 1882 he was appointed a naval assistant in the Hydrographic Department, being promoted to staff captain in June 1894. He retired as a captain in 1898, continuing to serve in the department until 1909. From 1903 he held the allowance post in charge of Sailing Directions, of which he became the first superintendent in 1907. During the 1914–18 war he rejoined the department and compiled supplements to those Sailing Directions covering areas of strategic importance.

COMMANDER H. J. STANLEY, R.N.

1867–1878

Henry James Stanley was in the *Saracen*, Stanton, surveying in the China Seas from 1859 to 1862. In 1863 he was promoted to master, and appointed assistant to Jeffery on the Queensland survey until 1866. Stanley was then transferred to the survey of Victoria, taking charge of it in 1867 on the death of Wilkinson. He remained there for ten years, being made a staff commander in 1873. The survey of Victoria was closed in 1878 as the result of a political development at Melbourne, and Stanley received no further employment. He was retired for non-service in March 1884.

STAFF COMMANDER J. T. GOWLLAND, R.N.

1868–1873

John Thomas Gowlland joined the Navy in 1853 and began surveying in 1858. He served for six years under Richards in the *Plumper* and the *Hecate* on surveys off Vancouver, being promoted to master in 1863. In 1864 he joined the *Hydra*, Mansell, in the Mediterranean, but a year later went to the New South Wales survey under Sidney. In 1868 he took charge of this survey, continuing it for five years. On return to England in 1873, Gowlland was appointed a naval assistant in the department and was made a staff commander in 1874. In that year he returned to New South Wales in colonial employment. On 14 August 1874 he was drowned while sounding in Sydney Harbour.

CAPTAIN G. STANLEY, C.B., R.N.

1870–1879

George Stanley joined the *Pandora*, Drury, in 1851 and spent five years on the survey of New Zealand waters. On returning home in 1856 he spent the next five years under Otter, mainly in Scottish waters. In 1861, Stanley was promoted to master and went to the *Swallow*, Wilds, surveying off China and Japan. During the latter part of this five-year period, Stanley commanded the tender *Dove*. In 1867 he went to the *Scorpion*, Parsons, in the West Indies and in 1870 he took charge of this survey for the next five years, being made a staff commander in 1872. Ill health forced him to return home in 1875, and he served again under Parsons in the *Porcupine* on the east-coast-of-England survey until 1877 when he took charge of the west-coast-of-England survey. Two years later, in December 1879, he joined the department as surveying officer in charge of Chart Branch, a post he filled with distinction until 1906, although in 1903 Wharton 'discovered' that Stanley was over sixty-five years of age and obtained a special continuation of his services. Stanley was promoted to staff captain in 1886 and retired as a captain on 20 June 1894. He was awarded the C.B. in 1902. His evidence contained in the report of the 1905 committee formed to inquire into the Hydrographic Department is of interest. In retirement he was employed on the computation of tidal predictions until his death in 1913.

STAFF COMMANDER J. H. ELLIS, R.N.

1870–1881

John Henry Ellis began surveying in 1851 with a five-year commission in the *Pandora*, Drury, on the New Zealand survey. This was followed by six years in the *Actaeon*, under the successive commands of Bate and J. Ward, off China and Japan. In 1862, on promotion to master, Ellis returned home and was three years as assistant to J. Richards on the Channel Islands survey. In 1865 he was transferred to the *Lightning*, E. J. Bedford, on the west coast of England where he served for three years. In 1868 he went to the *Rifleman*, Reed, on the China Station, but after eighteen months he was sent in charge of a survey of Aden Harbour, made at the request of the Indian Government. Returning home, Ellis next served for four years in the *Porcupine* on the east coast of England under the successive commands of Calver and Parsons. In 1876 he became deputy superintendent of Marine Surveys in India under A. D. Taylor; he served in this post for four years and was made a staff commander. Home again in 1880, Ellis took charge of a survey of the Clyde, and a year later was again in the *Porcupine*, Parsons, on the east coast of England. In March 1882, Ellis retired from active service, having been continuously employed on surveying for over thirty years.

ADMIRAL J. MORESBY

1871–1874

John Moresby was the son of Admiral of the Fleet Sir Fairfax Moresby, and a nephew of Captain R. Moresby of the Indian Navy, whose name appears in Part I of Dawson's *Memoirs*. Although he was never in the surveying service, the inclusion of his biography is justified by reason of his contribution to the hydrography of New Guinea when in command of H.M.S. *Basilisk*, 1871–74. A detailed description of his career would be inappropriate; its more interesting features are therefore given.

Moresby entered the Navy as a first-class volunteer in 1842, becoming a lieutenant in 1851. His first contact with surveying was in the Baltic campaign of 1854 when H.M.S. *Driver*, in which he was first lieutenant, came under the orders of Sulivan in the *Lightning* during a survey of the approaches to Bomarsund. In 1856 Moresby was flag-lieutenant to Admiral Chads, commanding the Ireland Station, until the latter hauled down his flag in 1858. Moresby was then promoted to commander. He commanded H.M. Ships *Snake* and *Argus* on the China Station. He took part in the bombardment of Shimonoseki in the *Argus*, and was promoted to captain in 1864. Moresby was then on half pay for over six years, during which time he obtained work on the west coast of Ireland as a marine surveyor, but not in any way connected with hydrographic surveying.

Moresby's work in H.M.S. *Basilisk* from 1871 to 1874 was a great achievement entitling him to a place among distinguished contributors to hydrography. Only in the last year did he have the assistance of a surveyor, Dawson, who was sent out to him by Richards. He explored and surveyed some 1 200 miles of coastline in New Guinea and the adjoining archipelago, adding many harbours, navigable rivers, and some 140 islands and islets to the charts. Port Moresby is named after him. His explorations were of particular value in opening up the possibilities of a quicker and better route between Australia and China. On 24 April 1873 he landed on Hayter Island, off the eastern extremity of New Guinea, and read the following proclamation:

> I, John Moresby, Captain in the Royal Navy, commanding H.M.S. *Basilisk* having discovered these considerable islands, from henceforth to be known as Moresby, Hayter, and Basilisk islands, off the east coast of New Guinea, together with various groups of detached islets, and deeming that the possession of these islands may hereafter prove of considerable importance, do hereby, by right of discovery, take possession of all the aforesaid islands and islets lying within the parallels of 10° 25′ and 10° 40′ South latitude, and between the meridians of 150° 35′ and 151° 20′ East longitude, in the name and on behalf of Her Most Gracious Majesty Queen Victoria, her heirs and successors, in token whereof I have hoisted and saluted the British flag on the shores of these islands. God Save the Queen. H.M.S. *Basilisk*, Possession Bay, Hayter Island, April 24th 1873.

After leaving the *Basilisk*, Moresby was employed in charge of a coastguard district, and as Captain-in-Charge, Bermuda, before his promotion to rear-admiral in 1881. He never flew his flag, and on the Retired List was advanced to vice-admiral in 1888 and to admiral in 1893. He died in 1922.

Staff Commander J. MILLARD, R.N.

1874–1881

John Millard began surveying with two years under Wood on the north-west coast of Scotland. In 1856 he went to the Mediterranean where he spent the next twenty-five years on various surveys. The first ten years were principally in the *Firefly*, Spratt, and the *Hydra*, Mansell, and then a further two in the *Hydra* with Shortland, by which time Millard was a master. He received the thanks of Their Lordships for his zeal and attention during a deep-sea sounding cruise in the *Hydra*, 1867–68. In 1868 he transferred to the *Newport*, Nares, and in 1871 to the *Shearwater*, whence he was invalided in 1874. Millard was then borne on the books of the *Hibernia* for Mediterranean surveys and carried out independent surveys, such as Port Said and Famagusta. He was made a staff commander in 1875, and in 1877 went to the *Fawn*, Wharton, in the Red Sea. In 1881 he was in England with Tizard in the *Knight Errant*, but in 1882 he was back in Malta, where he died that same year.

Vice-Admiral R. H. NAPIER,

1876–1881

Richard Henry Napier was in the *Herald*, Denham, on South Pacific surveys from 1852 to 1858. He then returned to general service until 1876, and during this period commanded H.M. Ships *Triton*, *Bullfinch*, and *Torch*, respectively, on the South America, Persian Gulf, and Mediterranean Stations. He was promoted to commander in 1868. In 1876 Napier took command of the *Nassau* surveying on the east coast of Africa and on the China Station, was promoted to captain in 1877 and transferred in 1878 to the *Magpie* for three further years surveying in the same waters. From 1882 to 1884 he was revising the *China Sea Directory* and in 1886 went as Captain-in-Charge, Ascension Island, where he remained until his retirement in 1890. On the Retired List he was advanced to rear-admiral in 1892 and to vice-admiral in 1898.

Lieutenant J. St CLAIR BOWER, R.N.

1880

James St Clair Bower served as a lieutenant from 1875 to 1877 in the *Nassau* under the successive commands of Gray and Napier, surveying on the east coast of Africa and the China Station. From 1877 to 1880 he was navigating officer in H.M.S. *Danae* at the Cape and in West Africa, being commended for surveys undertaken during this appointment. He commanded the *Sandfly* in July 1880 for surveys in the Solomon Islands, but in October that year he and a boat's crew from the ship were foully murdered by natives on Florida Island.

COMMANDER F. W. JARRAD, R.N.

1881–1890

Frederick William Jarrad joined the *Firefly* in the Mediterranean in 1862 and served as second master in her and in the *Hydra*, Mansell and Shortland, for six years. In 1868 he was appointed to the *Sylvia*, serving successively under Brooker and St John on surveys off China and Japan for two years, during which time he was made a navigating lieutenant. He then did four years in home waters in the *Porcupine*, Parsons and Kerr, and in 1874 was lent to the Marine Survey of India under A. D. Taylor, being made a staff commander in 1880. Returning home in 1881, Jarrad was in charge of a survey of Wexford Harbour, on completion of which he joined the west-coast-of-England survey under Archdeacon. In 1885 he went to the Western Australian survey under Coghlan, and in 1887 to the Newfoundland survey under W. F. Maxwell. In 1890 ill health terminated his active career and he was placed on the Retired List with the rank of commander in 1892.

PAYMASTER W. BLAKENEY, R.N.

1851–1882

William Blackney was born in November 1834 and entered the Navy as a master's assistant in December 1849. In August 1851 he joined the *Pandora*, Drury, surveying in New Zealand waters, became a clerk in July 1853, and presumably acted as an assistant surveyor. From June 1856 to May 1859 he served in the *Actaeon*, Bate, being promoted to assistant paymaster in September 1856. He was appointed to the *Fisgard* for the surveying service in June 1862 and from January 1864, the date of his promotion to paymaster, he was a member of the surveying party in British Columbia under Pender. In January 1866 Blackney arrived home from Vancouver to become the junior assistant in the Hydrographic Department, and as such was styled ' civil ' until in 1870 all assistants were styled ' naval '. In November 1868 the spelling of his name became Blakeney. On 9 December 1880 Blakeney was made the first Chief Civil Assistant to Evans and was given certain signing powers on administrative matters in order to relieve the Hydrographer. Early in 1882 Blakeney succumbed to nervous exhaustion, ' brought about by continued application to his official duties ', and went on three months' sick-leave, from which he did not return to duty. In September of that year Blakeney was retired with the rank of paymaster-in-chief.

H. SHARBAU

1865–1873

Henry Sharbau merits a biographical notice, despite his short service, because of his special attainments. Moreover, his son followed him into the department. He was born in 1822 at Lübeck in Germany and came to England as a young man with such talents in surveying and draughtsmanship that he joined the Ordnance Survey. From 1858 to 1864 he was with the Admiralty hydrographic surveys on the west coast of Scotland, successively under Thomas, Otter, and Bedford. In the last year he drew the fair chart of Loch Sunart which is one of the outstandingly beautiful documents in the department's archives.

From 1865 to 1873 Sharbau was a draughtsman in the department, but owing to his age at entry he could not fill an established post. He was among the first to receive extra pay for translation work in the department. Subsequently, then a naturalized British subject, he was two years with Japanese Government surveys, and after other appointments in England he joined the Royal Geographical Society in 1881. He remained as their chief draughtsman for twenty-three years until his death in 1904. His son, F. H. Sharbau, was in the department from 1890 to 1928, as a cartographer until 1922, and then as chief cartographer.

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Rear-Admiral Sir W. J. L. Wharton, K.C.B., F.R.S.

HYDROGRAPHER 1884–1904

AFLOAT

Archdeacon, L. S. Dawson, Pullen, Coghlan, Moore, Aldrich,
G. E. Richards, Maclear, Tizard, Carpenter, Hoskyn, White,
Oldham, Vereker, Boulton, Havergal, Balfour, Pirie,
Frederick, Howard, Gedge, Lyne

ASHORE

Underhill, Powell, Carrington, Boyle

William James Lloyd Wharton was born in 1843, the second son of Robert Wharton, barrister-at-law. He entered the Royal Navy as a cadet in 1857, being among the first to undergo training in the *Illustrious* before join a seagoing ship. He served as a midshipman from 1858 to 1860 in H.M.S. *Euryalus* of the Channel, and later the Mediterranean, Fleet, his service including a cruise to the Cape. He was then in H.M.S. *Jason* on the North-America-and-West-Indies Station until 1864, when he returned home as an acting lieutenant; and in the subsequent examination for lieutenant, he was awarded the Beaufort Testimonial. His first experience of surveying was in 1865 in the *Gannet*, Chimmo—one of two ships commissioned in Richards's time for general service with surveying as a secondary role—on the North-America-and-West-Indies Station. When she paid off in 1868, Wharton was appointed Flag-Lieutenant to Vice-Admiral Sir James Hope, Commander-in-Chief, Portsmouth. He was promoted to commander in March 1872, and in the following month took command of the *Shearwater*, surveying first in the Mediterranean, taking in the Dardanelles, and later on the Zanzibar coast, including a visit to Rodriguez with observers for a transit of Venus in 1874. The *Shearwater* arrived home in August 1875, her ship's company having suffered considerably from fever during the commission. In 1876 Wharton was appointed in command of the *Fawn*, and, after some work in the Red Sea, he continued surveys on the east coast of Africa until 1878. The ship was then ordered to the Sea of Marmara where the Fleet needed charts at the conclusion of the Russo-Turkish war. Wharton paid off the *Shearwater* at Malta at the end of 1880; he was promoted to captain that year, and in March 1882 he assumed command of the *Sylvia* for surveys in the Magellan Strait, where another transit of Venus was observed in December 1882.

In March 1884, Wharton was ordered home, succeeding Evans as Hydrographer in July. He was then forty-one and held the appointment for twenty years, a tenure exceeded only by Beaufort. He was retired as a rear-admiral on 1 January 1895, made a C.B. the same year, and a K.C.B. two years later. He was elected a Fellow of the Royal Society in 1886, and was a Fellow of the Royal Geographical and Royal Astronomical Societies. On relinquishing the post of Hydrographer to Field in August 1904, Wharton was specially granted a rear-admiral's pension and went to South Africa where he died of enteric fever at Cape Town on 29 August 1905 at the age of sixty-two.

He was the author of *A Short History of H.M.S. ' Victory '* and of *Hydrographical Surveying*, and he edited in 1893 *Captain Cook's Journal during his First Voyage round the World*. According to Edgell, who joined the surveying service in 1902 and became Hydrographer in 1932, ' Wharton was a man of great charm, and though on occasion he could be severe enough, he was always ready to help in case of difficulty, and his great knowledge was of inestimable value to the service '.[1]

The contemporary scene

During Wharton's period of office, Britain's naval supremacy continued to be a major factor in world affairs and there was opportunity to demonstrate it at the Spithead reviews[2] held to mark the jubilees of Queen Victoria's reign in 1887 and 1897 and the accession of Edward VII in 1901. This supremacy was largely responsible for the continuation of Britain's era of peace, the *Pax Brittannica*, that had begun in 1815 after Waterloo and had been disturbed only by the Crimean war in 1854–56. It gave her freedom from interference by Powers unfriendly towards her actions in South Africa at the close of the century.

The Naval Defence Act of 1889 was passed to ensure that the British Navy should be superior to the combined naval strength of any two other Powers. The years 1898 and 1900 saw the naval laws of Germany, designed to strengthen her fleet, preceded in 1895 by the completion of the Kiel Canal and the fortification of the island of Heligoland, handed to Germany by Britain in exchange for Zanzibar in 1889. In 1903 Britain established a naval base at Rosyth; and the two navies were to be at grips twice in the first half of the twentieth century. Meanwhile, the Hydrographic Department became increasingly involved in naval-defence measures.[1]

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[1] *Sea Surveys*, 1948—Bibliography 3, 6.

[2] The department's archives contain copies of charts prepared for reviews of the Fleet. Earlier recorded occasions at Spithead were in 1856 after the Crimean war, in 1867, and in 1873. There is an original drawing by John Crane, master of the *Courageux*, of ' The Situation of H.M. ships at Spithead, Friday, 8 May 1778 '. There is also a copy of the chart for the funeral procession of Victoria from Cowes to Spithead in 1901.

In Europe, Balkan rivalries continued. The Triple Alliance, formed when Italy joined Germany and Austria in 1882, was followed by a demonstration of Germany's friendship with Turkey when Constantinople was visited in 1889 by Kaiser Wilhelm II, who ' dropped the pilot ' Bismarck in the following year. In 1893 there was the counterbalancing Franco-Russian alliance and, after various attempts had been unsuccessful over the years to reconcile British and German interests, the Anglo-French *entente* came about in 1904; Britain's ' splendid isolation ' was at an end.

At the beginning of the period, in the early months of 1885, relations with Russia again became strained. This time it was due to the Penjdeh incident on the border between Russia and Afghanistan, from where Britain had withdrawn in 1880. There was an implied threat to India, and the Fleet was mobilized, until British diplomacy found a solution. At this time also there was much activity in the South Pacific and, with alarm growing in Australia at German and French acquisitions, Britain, at the end of 1884, decided to proclaim her protectorate over Eastern New Guinea. A redistribution of sovereignty over certain islands meant that Field in the *Dart* had instructions from the Hydrographer to sail ' as soon as affairs with Russia permit ' and remove British flags from several islands that had fallen to German protection. By 1900, Britain had taken possession of upwards of a hundred Pacific islands, dictated in part by the growing desire to connect Canada and Australasia by a telegraph cable. Wharton made a report on this proposal in 1887 stressing the difficulties; his further remarks in 1896 were repeated to the new committee for the project in 1899. He was then in favour of soundings being taken by the specially fitted cable-ships, adding that surveying ships were fully employed; but as later shown there were various deep-sea sounding cruises by surveying ships before the cable was laid in 1901. In the Indian Ocean there was the annexation of Christmas Island in 1888 by H.M.S. *Imperieuse* after the Hydrographer had said that it had never been inhabited or claimed by any Power. It had been visited the previous year by both the *Flying Fish* and the *Egeria*, as described later.

Also in the early part of the period, Britain completed her occupation of Burma in 1886 while the French became established in Indo-China. Of the former, Wharton wrote his congratulations to Carpenter of the Marine Survey of India in January 1886, referring to his opportunity of showing the practical value of surveyors in case of need, such as being in the van of the force up the Irrawaddy. He continued: ' It must have been an exciting expedition and though I daresay there was a certain amount of disappointment at the speedy collapse of opposition, it appears to me always more creditable that operations should be so conducted as to minimize the chance of fighting rather than depend upon a large butcher's bill.'

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[1] See p. 131.

In the Far East, Britain was the first to make a treaty of recognition with Japan in 1894. The latter's defeat of China, when Korea was the issue, came in that year, but the Powers insisted on her return of some territory, including Port Arthur. In 1897, Germany seized Kiaochow, Britain leased Weihaiwei, and Russia occupied Port Arthur. For the information of the Foreign Secretary, the Hydrographer said in 1898 that Port Arthur had been named after Lieutenant and Commander William Arthur of H.M.S. *Algerine* when, in 1860, that ship had been attached to surveying ships on the coast, and when the Chinese name of Lushun-kaw was not known. Also in 1898, Wharton commented on the capabilities of steam vessels to make the passage of the Yangtze in furtherance of trade with China. He advised against a Foreign Office request for a survey, and instead H.M. Ships *Woodcock* and *Woodlark* were to embark a Mr Little with local knowledge for the passage at the appropriate state of the river. As a result a valuable report was received in 1900. The Boxer outbreak of 1900 saw Britain's naval contingent playing a leading part in the international force to relieve the Peking legations, and the *Waterwitch* was involved. Subsequently, there was an Anglo-German convention to maintain the ' open door ' for trade with China. In 1902 there was the Anglo-Japanese alliance to counter Russian and German activity, and, incidentally, in that year the *Rambler* visited Yokohama for the fair charts of a season's work to be drawn. Britain's alliance with Japan and France's with Russia did not, however, lead to involvement in the Russo-Japanese war of 1904–5, during which Japan's unexpected naval victory demonstrated her rapid rise to power. Events could have turned out differently if Russia had not apologized handsomely after her Baltic Fleet, *en route* to the East, had fired on British fishing vessels on the Dogger Bank during darkness.

Meanwhile, on the African continent the Belgians joined the longer-established British, French, and Portuguese; and in 1879 Leopold II of Belgium formed the Congo Free State, annexing it in 1885. In the years 1886 to 1892, the Germans and Italians joined in an extension of European annexations in various treaties. There were three British chartered companies—Royal Niger, 1886; British East Africa, 1888; and British South Africa, 1889, the last having the authority to cross the Limpopo into Rhodesia. A minute of 1892 shows that Wharton had been visited by Dr Laws, who for the past sixteen years had followed in Livingstone's footsteps to Nyasaland, and with whose help, Wharton was able to describe to the Board how the proposed gunboats for Lake Nyasa, the *Pioneer* and the *Adventure*, should be ship-loaded up the Zambezi, put together at Matope, and steamed up the river Shire. Much of the route had been surveyed by the *Stork* in 1899. The Ethiopians were the only indigent race successfully to resist annexation when they defeated at Adowa in 1896 an Italian intrusion from Eritrea. Surveyors were involved in various coastal boundary demarcations and surveying ships were occasionally called upon to assist in local naval operations. One of the *Rambler*'s surveys in 1900 was of the South African coast, and when the Hydrographer supported Purey-Cust's application for the award of the South African Medal and gratuity to his officers and men, he said that the survey had been specially undertaken for the benefit of the navigation of transports close to the coast. There was a further sequel, when the report of the Committee on the War in South Africa was seen by the Hydrographer, as mentioned on p. 137.

Among the inventions of the period was the outstanding one of wireless telegraphy by Marconi in 1902. Details of stations were promulgated in Notices to Mariners and included in Light Lists, but the Hydrographer did not agree with the Marconi Company that wireless-telegraphy stations should be shown on charts. In 1885 came the first internal-combustion engine by Daimler in Germany, and in 1901 a tramway proposed by the London County Council for the Woolwich/Eltham district brought suggestions from the Astronomer Royal for obviating interference to magnetic instruments in the Royal Observatory at Greenwich. The penny farthing became the safety-bicycle. The typewriter was used in 1891 for an entry in the minute-books.

Exploration continued in the polar regions. In Antarctica, beside the many whaling and sealing expeditions, there were the first explorations of the continent. The Hydrographer advised the Board on various occasions, and particularly on the subject of the British Antarctic Expedition of 1901–4. For example, the Admiralty in 1893 supplied advance *Nautical Almanac* information for 1897 to Nansen's famous Arctic expedition, when the *Fram* drifted across the ocean, and Nansen by sledge and boat almost reached the Pole. In 1897 it presented charts to the Belgian Antarctic Expedition under Gerlache, the ship *Belgica* being the first to overwinter after being beset in ice; in 1899 it accepted from the Peary Arctic Club two relics of the Nares 1875–76 expedition, a sextant and a cairn, which had been found by Peary and which went to the Greenwich Museum; in 1901 it arranged coaling facilities at the Falkland Islands for Nordenskjöld's Swedish expedition; in 1902 it lent six chronometers to von Drygalski's German expedition to the Antarctic in the *Gauss*; and in 1903 it again provided advance *Nautical Almanac* information, this time for Amundsen's Norwegian expedition to the North Pole.

In 1888, a proposal for a British expedition to the Antarctic was made from Australia, and another in 1894 by the Royal Society and the Royal Geographical Society; but neither proposal was then developed. In 1898–1900 there was the privately sponsored British expedition in the *Southern Cross*, which carried the first scientific party to overwinter intentionally, at Cape Adare. Then, in 1901, the two above-mentioned societies jointly dispatched the British National Antarctic Expedition in the *Discovery* with Scott in command. Wharton served on their committee and incidentally urged the Board to allow Scott and Royds to count the expedition as ‘ sea time ’. The programme was comprehensively scientific and included the first extensive exploration on land. News that the *Discovery* was beset in ice in McMurdo Sound, Ross Sea, was received early in 1903. In May, Wharton pressed the Board to support a relief expedition, emphasizing the need for two ships. The Admiralty accepted responsibility, and in August Wharton, now chairman of the Antarctic Relief Committee, drafted instructions for Colbeck in the *Morning* (he had been in the *Southern Cross*), who was to be accompanied by McKay in the *Terra Nova*. There were also instructions for Scott, as the senior officer, on the arrival of the relief ships. In March 1904 Wharton reported to the Board in full the measures taken between the date of the appeal for help in May 1903 and the sailing of the relief ships from Hobart in December. In it was acknowledgement of the work of Aldrich who had had Arctic experience under Nares in 1875–76, and who now, with Shackleton's help, fitted out the *Terra Nova* at Dundee ' with great expedition '. To speed her passage via Suez to Hobart she was taken in tow by various cruisers. Later, when Wharton saw the report of *Discovery*'s proceedings[1] he remarked: ' Commander Scott and his staff have most magnificently maintained the high standard of efficiency of former polar expeditions.' Subsequent expeditions were the Scottish National Antarctic Expedition of 1902–4 led by Bruce in the *Scotia* and the French expedition of Charcot in the *Français*, 1903–5.

Departmental activity

Minute-books continued to record the day-to-day activities of the department and also the advice given on multifarious subjects; there were marginal comments by Board members and others. In 1897 a new system of files made unnecessary the previous arrangement whereby lengthy minutes or reports were collected in separate guard-books. There are also the letter-books containing correspondence with other authorities and Wharton's personal letters to officers in charge of survey afloat. A small proportion of documents has faded into illegibility. There is a contemporary description of the department at work by W. B. Lord in the *Nautical Magazine* of 1897; and statistics for the period were included in the report of the 1905 committee of inquiry into the Hydrographic Department.[2] What follows describes only the more important developments.

The first comprehensive Instructions for the Hydrographer were issued by the Board in January 1889, ' though they had been prepared some years back ', and they are given in full in Appendix D. Within three years of receiving them, in October 1891, Wharton had to take the opportunity to explain to the First Lord why the surveying service and Hydrographic Department were best a part of the Navy. It was presumably the first, and was not to be the last, occasion when the Board have had in mind a saving in the Navy Estimates or naval manpower. Wharton expressed his feelings in a letter to Tooker: ' Things are not so stable as they used to be and there is no saying what ideas may take possession of the Board. The perplexing dearth of officers may at any time drive them to extreme measures.' To the Board he reasoned: Admiralty charts had always been primarily for the Fleet in peace and war and were necessarily based on naval surveys, since the Fleet frequently went where merchant ships did not go and where war operations were possible. Many surveys were at the instance of commanders-in-chief abroad. There was a need for trained surveyors in war, examples being the Baltic and the Black Sea operations; and surveys required organization and discipline—the officers and men combining endurance with a sense of duty. It was evident they should be seamen. The office was an integral part of the naval organizations, and only surveyors could provide the superintending officers. A single, and naval, centre provided the sole repository for all original surveys and thus could best meet the needs of both the Fleet and the Merchant Navy. Surveying was learnt by practice and experience under others, and a reduction of officers might mean the dying-out of a sufficient school. The general service needed surveyors in war but also benefited by the return of some surveyors to it in peace. Wharton mentioned that the Americans had a Coast Survey, similar to our Ordnance Survey, but had found the need also for a Hydrographic Office staffed by seamen; and he did not refrain from referring to a rivalry between them. Concluding with the assumption that more accurate charts were urgently called for, he said, '. . . accepting that surveying is a necessity I submit that reason is shown why it should be mainly carried out by Her Majesty's Navy '. The notation of the First Lord, Lord George Hamilton, was: ' Read. The surveying service is admirably performed, but it locks up eighty-two officers in its duties.'

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[1] Records of this and other expeditions are at the Scott Polar Research Institute, founded at Cambridge as a memorial to Captain Scott and his companions who lost their lives in the return journey from the South Pole in March 1912. Debenham was the first director in 1920.

[2] Appendix C, 4.

The department's output of charts, notices, books, and so forth was included in the annual reports to Parliament; its expenses were shown in Navy Estimates, and there was a nominal list of its staff in *The Navy List*.

Wharton began with eleven naval assistants (including Compass Branch) and four civil assistants, as shown in letters of 1886 describing his organization to the U.S. and French Hydrographers. There was also a minute in that year on his return from a visit to Paris where he found twice the staff producing less. His senior assistants changed but seldom. The Assistant Hydrographer was Pender until 1891, and then Tizard. The Surveying Officer in charge of Chart Branch (again referred to in 1897 as Superintendent of Charts, though the title was not officially readopted for some years) was Stanley throughout, there being a two-year extension of his appointment in 1903 when Wharton ' discovered ' that he was over sixty-five. The chief draughtsman was Powell until 1892, Boyle until 1900, and then Clark. In charge of Sailing Directions

Room was J. C. Richards until 1903 when Langdon succeeded to this allowance post. The Chief Civil Assistant was G. W. Underhill until 1897, when failing eyesight led to his resignation. He had served as a paymaster-in-chief on the Retired List from 1893. Frederick succeeded Underhill, continuing as Chief Civil Assistant, although a change of title to Chief Naval Assistant was mooted; he was followed by Parry from 1901 to 1903. Then came the first civilian holder of the post, W. D. Barber. His ability was such that Wharton in 1890, and again in 1896, recommended him for special promotion, remarking that though the establishment did not include the higher grade he would ' view his departure with dismay '. Such a promotion problem was to recur during the ensuing sixty years; and Barber was in fact advanced to the new upper class of second-division clerk in August 1891.

The numbers and grades of the civilian staff were constantly argued with the Treasury, Wharton asking for an inquiry in 1900 in view of the increase in the volume and the confidential nature of the work. This obtained two second-division clerks vice a supplementary clerk and a hired writer. In 1902, after incoming registered papers had increased in 1901 to 7 547, a second assistant clerk (E. H. Walter) was added, so that there were in 1903: one staff clerk, Lindegreen (although the title ' for pilotage and accounts ' had ceased in 1894 when Dimsey retired and was succeeded by Sadler, until 1903); five second-division clerks, one with Sailing Directions since 1891 and one from 1900 being Llewellyn, later to be Chief Civil Assistant; and two assistant clerks. The messenger staff slowly increased, as did their rates of pay, from four in 1890 to nine in 1903; and in 1891 their descriptions were packer, original documents attendant, and Hydrographer's messenger.

The main items of expenses, which can be quoted from Navy Estimates, now came under Vote 6, Scientific, and separate from Education. Figures for 1890–91 (those for 1900–1 in parentheses) were: salaries and wages £12 321 (14 108); drawing and engraving £6 840 (9 000); printing and mounting £6 800 (11 500); surveying pay at home £2 308 (2 900) and abroad £5 179 (4 500); hire of vessels, lodging, and so on £10 827 (11 010); compasses £1 580 (1 700), new supplies being under another Vote; Royal Observatory £8 000 (9 080), Cape Observatory £3 660 (6 730); the Nautical Almanac Office £3 485 (4 040); chronometers £2 013 (3 910). Charts sold in 1889 were 161 063 at £8 829 and, in 1899, 278 701 at £16 915. Charts supplied to the public service in the latter year were valued at £14 506. The net total of Vote 6 rose from £57 900 to £66 900 in the years quoted; and the Estimates no longer showed the total cost of the surveying service by assembling details of stores, fuel, refits, and so on from other Votes.

The accommodation slowly increased, three extra rooms in the 'old' building being added in 1887 on their vacation by the Foreign Intelligence Committee. After continuing discussion of plans begun by his predecessor in 1882, the Hydrographer had, in 1895, to accept the decision that his department was not after all to move into the new building but was to make do with more rooms in the old building, and await the new wing, ' about to be constructed '. New planning was begun, including lighting by electricity or incandescent gas; even then, the Hydrographer had in 1899 to resist strenuously a proposed appropriation of his rooms to others, pointing out how much money had been wasted in the preparation of rooms in the new west wing during 1895. The move to the second floor of the north wing was effected by 1901, according to minutes which continued with increasing acerbity into 1903 about smoke and smuts from the downdraught into fireplaces. The Office of Works said the appearance of the building would suffer if cowls were fitted on chimneys near the dome—the nuisance persisted for some twenty-five to thirty years! Some attics were retained in the old building for instruments and books.

Naval assistants continued to come from the Active or Retired Lists, and Wharton argued with the Treasury from time to time for improved salaries. His first appeal for an addition to their number in 1884 was in order to help with Notices to Mariners and instruments. Notices were increasing in number, and instruments in value, and had, he said, been overlooked by the 1883 committee. The solution was, however, to transfer to the Board of Trade in 1885 the distribution of Notices to various mercantile bodies, although there remained with the department ninety-four addressees besides ships of the Fleet. In that year there were 243 Notices having a printing-run of 1 500. In 1890 there were 644 Notices, and a weekly edition of a smaller format was introduced for distribution to each of H.M. ships instead of a selective issue of single Notices depending on the charts carried. By the end of the period the number of Notices in a year was over a thousand. In 1897 Wharton explained to the Commander-in-Chief, Australia, that charts with the same date of correction might differ if the normal issue direct from the printing plate had to be supplemented in special cases from stocks on the Admiralty shelves. He said that some information had to be appraised as unimportant to navigation, and though inserted on the plates, it was not issued as a Notice to Mariners. This problem has long exercised the attention of the department and will be referred to again.

A second appeal for more staff in December 1886 made comparisons with the staffing of the French and U.S. offices, commenting that the latter used our charts almost exclusively save of their own coasts; this appeal was, however, stood over by the Board as being singularly inopportune, the Treasury having just agreed to a Foreign Intelligence Division.[1] Arguments in October 1888 were more successful. They referred to the threatening breakdown of the one-man system in Chart Branch, and to the risk of paralysis in Chart Issues Branch, a title used for the first time. A greatly increased number of charts was being distributed consequent on the improved state of readiness for war and other general causes, any paralysis having been averted by diverting an officer from time to time from another branch, which, incidentally, could ill afford it. ' The whole department, if its work is to be properly done, and its efficiency as the principal hydrographic establishment in the world maintained, requires expansion. Want of space prevents for the present a thorough reorganization, but the technical assistance most urgently wanted, viz. two naval surveying officers and two draughtsmen can be squeezed into the present rooms.' The Treasury agreed in May 1889, not without adding a typical rider to the effect that too many branches should be avoided, and that more work might be given to less-highly-paid staff. In 1896 two more draughtsmen, besides a clerk for chart issues, were approved; and in 1899 two more, this time on the death of Carrington, who, working outside, had been ' capable of the work of two or three ordinary draughtsmen '. Lastly, in 1903, another naval assistant was approved in the light of statistics assembled by Wharton, who accordingly handed over to his successor an establishment of one Assistant Hydrographer, one Surveying Officer in charge of Chart Branch, nine naval assistants, one Surveying Officer for Special Business, one chief draughtsman, and twelve draughtsmen.

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[1] The Foreign Intelligence Division was the origin of the Naval Staff, having been recommended by the Foreign Intelligence Committee, which sat from 1882–86. The First and Naval Lords and the First and Second Secretaries living on the premises had sufficed during and after the Napoleonic wars. Prior to Dalrymple's appointment as Hydrographer in 1795, the Board had no professional adviser and there had been only one other, the Director-General of Naval Ordnance in 1866. The Naval Intelligence Department, as it became known, covered mobilization and war plans and foreign intelligence, to which were added trade in 1902 and coastal defence in 1905. The title Sea Lord was reintroduced by Fisher in 1904. (*The Naval Staff of the Admiralty*, September 1929.)

The distribution of work among the naval assistants at that time can best be seen in the report of the 1905 committee.[1] In Sailing Directions Room, two naval assistants (one with an allowance) organized and checked revisions by retired officers working at home. They also circulated all incoming hydrographic information within the department, recording it in interleaved copies of Sailing Directions first printed in 1857. One naval assistant assisted in Chart Branch, and there were two on chart issues. One drafted Notices to Mariners and prepared the annual Tide Tables, for which the calculations were mainly done outside; another handled chronometer issues and prepared supplements for Sailing Directions. The Surveying Officer for Special Business was in charge of instruments and equipment matters, kept deep-sea sounding records and drafted the annual report. Of the remaining two naval assistants, one kept the Light Lists and ' Dock Book ' and the other digested for the Hydrographer the results of special investigations, such as of Gibraltar Strait currents.

Chart Branch's output in 1884 (1903 in parentheses) was: new charts 55 (96); charts improved by the addition of new plans 10 (30); charts largely corrected 170 (223); chart-plate corrections 2 516 (5 300); charts corrected by draughtsmen 36 500 (50 270). These figures refer to navigational charts and, as the increase in their total number in the catalogue was from 2 683 in 1885 to 3 089 in 1901, the rate of cancellations by new charts, as well as by the adding of plans to, or otherwise largely correcting, existing plates was considerable.

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[1] See p. 211.

The publication *Notes bearing on the Navigation of H.M. Ships*,[1] in 1889, said that charts were usually issued fresh from the plates and were thereafter corrected by hand. Larger corrections were put on plates and the issue of fresh copies followed. The dates of large corrections were noted on chart plates at the bottom middle, those of the smaller corrections at the bottom left, e.g. 'September '89' or 'ix. '89'.

In 1895–97 twenty-two monthly or quarterly Current charts for the Indian, the Pacific, and the Atlantic Oceans were published, and in 1901–3 twenty-four monthly Wind charts for the South American coasts and the South Atlantic. In 1899 came the Tidal-stream charts for United Kingdom waters (to be discussed), followed in 1903 by a set for the Channel Islands. Sizes of charts continued to cover a wide range, but the double-elephant began to preponderate, and the number of charts smaller than ½DE was reduced to less than a hundred. Typical prices were two shillings and sixpence for a DE, one shilling and sixpence for a ½DE, and four shillings for a long DE.

There was a new production in 1889 of a chart of the world showing coaling and telegraph facilities. In 1893 Wharton would not follow the United States in producing a chart of derelicts in the Atlantic on the grounds that the expected results would not justify the expense. There followed a departmental committee, and Nares, now at the Board of Trade, suggested one reason for the large number of derelicts was the overloading of timber-ships. In 1896 three charts of oceanic soundings in the Atlantic, the Indian, and the Pacific Oceans were published. They had been preceded from 1889 by annual lists of oceanic depths and serial temperatures received from surveying ships, the Indian Marine, and telegraph companies. Accordingly, when in 1901 the Pacific Cable Company raised the security question, Wharton referred to a policy of thirty years' standing that had in fact helped to decide the Pacific cable route. He added, '... to suppose an enemy intent on cutting cables would have no other information than the Admiralty charts was a poor compliment to Intelligence Departments'. The Director of Naval Intelligence agreed, and the Admiralty reply was: 'The Admiralty are following a course which has proved of great advantage to British cable companies all over the world and Their Lordships do not consider that any disadvantage attaches to it compared to the great general advantage of the fullest publication of the knowledge gained of the depths of the oceans.' A chart showing telegraph cables, prepared in 1884, was supplied only to commanders-in-chief. In that year the International Convention for the Protection of Submarine Telegraph Cables was held, and certain of its Articles were later included in Sailing Directions. See also page 265.

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[1] See p. 130.

Cartographic styles changed little. Wharton very soon, in 1885, wrote to Tizard, in the *Triton*, that in future underlined figures on drying banks would mean their height in feet above L.W.O.S., the sounding-datum. He appreciated that the alternative of meaning the depth at H.W. had its special value also, but a dual system could lead to mistakes. In 1894 the magnetic-compass rose was shown in degrees as well as points. In 1899 there was a large correction of the abbreviations sheet published by Richards in 1866. Small position-circles at the base of buoys and the like were not used, although they had been tried in Beaufort's day. The indexes of original documents were improved to include those of a date anterior to the formation of the department; and for this purpose Parry was appointed for one year in October 1900, being succeeded when he became Chief Civil Assistant in January 1901 by Pudsey Dawson.

Engraving continued to be concentrated in the two firms, Davies & Co., and Weller. In 1886 the pitting of plates gave trouble, the steeling process, cleaning methods, and the printing-ink being suspect; and the chemist at the Royal Naval College, Greenwich, suggested remedies. In 1892 a French engraving-machine was considered unsuitable for the soundings on Admiralty charts. In 1902, after consultation with the Ordnance Survey, there were trials of a method of depositing new copper on scraped-out portions of plates. In 1887 there was a security arrangement whereby dry proofs of all new plates were pulled and stored in the Admiralty. In fact, there was continual worry about the fire risk at the printer's, Malby's, in Drury Lane and 'in the immediate vicinity of the Freemasons' Tavern with its huge cooking-apparatus constituting in itself a danger of unusual proportions'; and a special police watch was instituted in 1886. In that year Wharton argued with H.M.S.O. that no-one but Malby could do the work, and that the alternative of a Government establishment such as the Ordnance Survey would be most expensive. After the Treasury had refused to sanction the rent of a new vault, Malby agreed in 1887 to alter the existing one provided the printing and engraving of Admiralty charts were secured for him for three years at the charges then ruling. The matter came up again, when in 1904 Malby moved to Little Grays Inn Lane. Meanwhile, in 1891 the Hydrographer proposed the major step of duplicating chart plates by electrotyping, based on an estimate of £14 per plate from Elkington & Co. The Board approved, but were not unanimous, and Navy Estimates showed an allowance of £14 000 spread over fourteen years starting in 1892–93.

Timely issues of charts and so on to the Fleet were of increasing and recurring concern. In January 1885 the Hydrographer estimated the time needed to supply, in an emergency, a number of sets to cover certain foreign stations, adding that chronometers and compasses would be available as fast as the ships in reserve could be got ready. The mobilization in May of that year, however, found ships delayed at Plymouth. Admiralty stocks were depleted although 20 000 more charts than the average had been printed in

April. Transfers from Portsmouth depot could not be made as it was Saturday afternoon! In 1888 it was proposed to hold reserves for ships listed by the Naval Intelligence Division as ready for commissioning, and charts to cover the French coasts for all ships in reserve if war with that country threatened. In 1897, according to Lord's account of the department, there were in circulation to the Fleet, 895 boxes, each containing over 300 charts, and more than a thousand chronometers and deck-watches.

The principal chart depots were at Portsmouth, Devonport, Sheerness, Gibraltar, Malta, Hong Kong, the Cape, and Sydney, with subsidiary stocks elsewhere, e.g. Bermuda and Jamaica. Arrangements at the depots were slowly improved, often in the face of Treasury objections. An argument put forward in 1886 stated that it would be preferable to maintain, rather than destroy, 18 000 charts returned after Fleet manoeuvres. The staffs to assist the responsible part-time navigating staff officers of the Fleet were gradually supplemented by writers and, later, pensioners, the depots becoming 'chart and chronometer' depots. For instance, at Malta in 1903 there was the appointment of an officer-in-charge, Staff Commander F. Roberts, and the taking-over of chronometer stocks from Mr Barthet of Valetta, who had maintained them since 1886 and now received Their Lordships' approbation. Next year the responsibility of the time-ball service was added. At Devonport the depot was moved to the Royal William Victualling Yard in 1902. Labels were instituted in 1889 for pasting into chart-box lids with the issuing officer's certificate of correction; locks and keys were discarded in 1898. A new issue to the Fleet down to third-class cruisers occurred in 1904, comprising an atlas of charts for information purposes supplementing the folios held. This issue was at the suggestion of Captain H. F. Oliver.[1]

Sales of charts continued in the hands of Potter, with whom there was a new agreement in August 1884, which included the supply to him, as in map practice, of thirteen charts to the dozen rather than an allowance of seven per cent on his bills as had been mooted in 1865. When Septimus Potter died in 1898 the agreement was transferred to Edward Octavius. The number of subagents in 1855 (figures for 1901 in parentheses) was: 43 (52) in U.K. and 31 (44) abroad, those in 1901 being distributed among 68 ports.

The agent asked in 1898 whether it was in order to sell charts to the U.S.A. and Spain during the hostilities that arose between those two countries in Cuba. Wharton argued: 'If neutrality permits, it is very desirable to place no restriction upon such supply, as anything which tends to cause foreign nations to depend upon Great Britain in getting about the world is manifestly to the advantage of Great Britain if engaged in war herself.' The Board accepted legal advice, to the effect that it was a refinement of neutrality obligations that need not be referred to the Foreign Office, and that there should be no interference with sales, which would be futile in any event, since charts would still be obtained through a third party.

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[1] H. F. Oliver, who became an Admiral of the Fleet, volunteered for surveying when a lieutenant and served in the *Stork* from 1889, recommissioning her as navigating officer in 1892. He was, thereafter, often in touch with the Hydrographic Department, and was a member of the committee formed in 1905 to inquire into the department.

In 1899, R. H. Laurie,[1] in whose hands much of the private chart-trade had become centred, wished to sell his stock of plates to the Admiralty. Wharton's comment regretted the diminution of the private trade, which had originally met a need, and expressed the view that, although there was financial gain, sales gave trouble and resulted in undue wear on chart plates. A different view was to be expressed to the 1905 committee when the relief that sales receipts afforded to the Navy Vote for the department was emphasized. In 1901 Laurie challenged Potter's issue of a pamphlet, *The Law Relating to Charts and S.D.s.* Wharton pointed out that it had been written by a well-known barrister, and contained decisions in courts of law that favoured Admiralty charts. He wrote a long minute on past history and, while being sympathetic towards Laurie, drafted a reply:

> Their Lordships cannot admit that it is otherwise than proper to permit the Mercantile Marine of this country to supply themselves at as low a price as possible with charts prepared at the cost of the taxpayer primarily for the use of H.M. ships but generally for the benefit of the whole community. Their Lordships would also point out that the character and scope of the charts prepared by the Memorialists and other private publishers and those issued by the Admiralty is so different that they can scarcely be held to compete with one another.

The question of copyright arose in 1887 and 1903. In the first case the Hydrographer represented to the Treasury and H.M.S.O. that the reservation of rights for Government publications ought not to mean that no reproduction of charts should be permitted. Similarly, when the Royal Society raised the matter in 1903, the Hydrographer strongly favoured permission to reproduce so long as reproductions were not in a form suitable for navigation. There was no mention of any charge.

Sailing Directions, now regularly entitled 'Pilots' although some Directories remained, continued to number about fifty-seven. More than a dozen books were regularly under revision. Retired officers continued to be employed as revisers, and when the Treasury tried in 1890 to alter the terms of ten shillings per diem of six hours, Wharton wrote about 'an incitement to fudge the hours' and 'do the Treasury'. A sum of £750 was allowed for revisers in the 1901–2 Estimates. Supplements had completely superseded Hydrographic Notices as a method of correction by 1898; and ten years earlier the system had been introduced of supplying correctional information in duplicate with one copy to be used for cutting up and pasting into the books.

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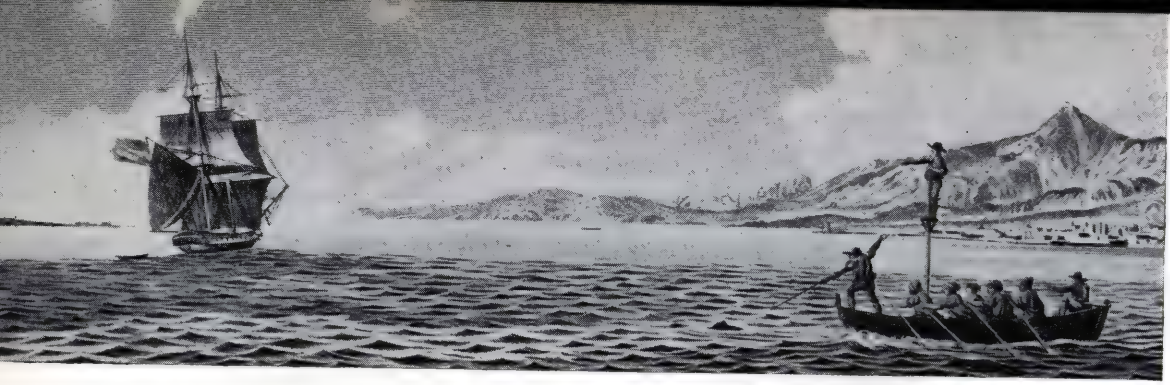
[1] According to Stanley's evidence to the 1905 committee, there had been in the 1880's several firms selling 'blue-backed' charts. However, Board of Trade inquiries into casualties advocated the use of Admiralty charts and, owing to insufficient sales, the firms were gradually compelled to give up. Three of them, Imray, Norie & Wilson, and Laurie combined to make one firm.

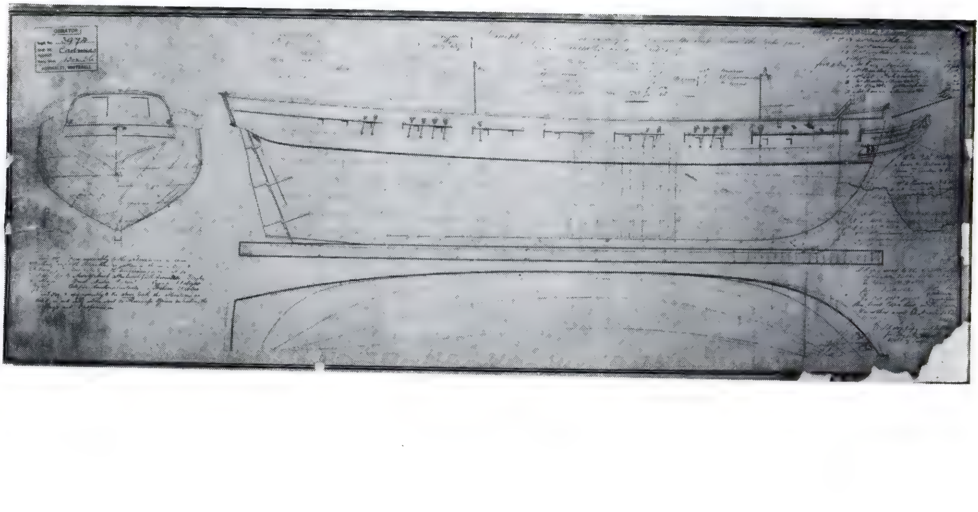
SURVEYING SHIPS OF THE PERIOD

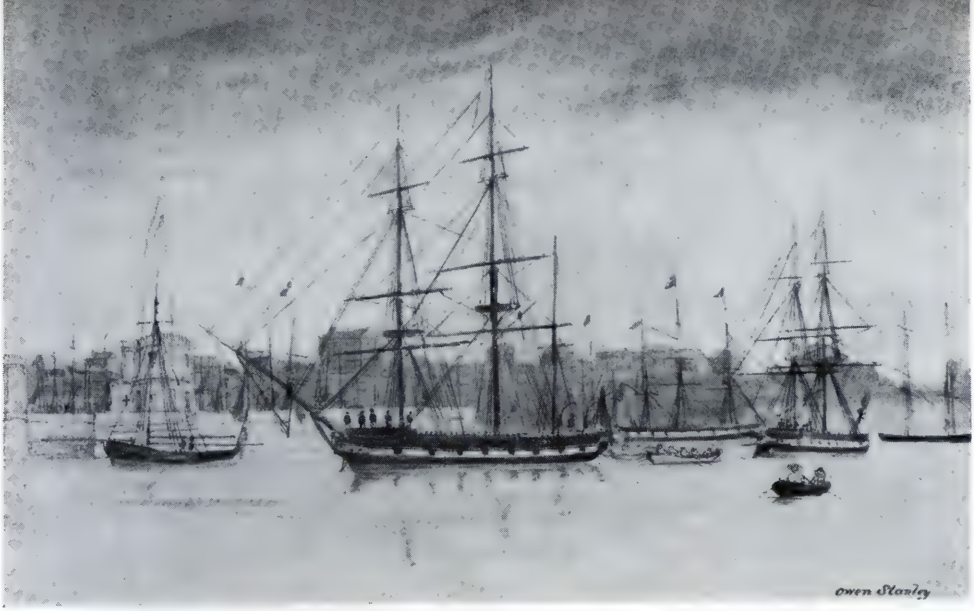
1. 1811–1836. *Investigator*, length 75 ft, beam 19 ft, 121 tons, complement 20. Built at Deptford for surveying in 1811, the *Investigator* was the first vessel to be so built and was at once 'established' by G. Thomas, master, who remained in command for the twenty-five years of her surveying life. Except for a period in 1812 off the enemy-held coast of Walcheren, for which she was armed with six carronades, the *Investigator* was employed in home waters. Initially her surveys were various on both coasts of England and Scotland with one, Kingston Harbour, in Ireland in 1833, but from 1825 she was principally in the Shetland and Orkney Islands. In 1836, the *Investigator* was converted at Woolwich for use by the Thames River Police, and she was finally broken up in 1857 at Deptford where she had been built forty-six years earlier. The name *Investigator* was used earlier for Flinders's sloop in Australian waters from 1801–3 and for an Honourable East India Company ship from 1807–40. McClure's ship in the Arctic, 1849–54, was also named *Investigator*. The Indian Marine have used the name for their surveying ship since 1885. No illustration of the *Investigator* has been found, but one of a contemporary vessel, the brig *Penguin*, is reproduced here. *By permission of the Trustees of the National Maritime Museum.*



2. 1817–1830. *Aid,* later *Adventure,* length 105 ft, beam 26 ft, 314 tons, complement 50. Built as a transport at Lynn in 1808, the *Aid* was converted for surveying in 1817 and sent out from England for Smyth's use in the Mediterranean. Recommissioned and renamed *Adventure* in 1821, she continued on Mediterranean surveys under Smyth until 1824, giving her name to Adventure Bank. From 1825 to 1830, the *Adventure* was on the Magellan Strait survey under King and in company with the *Beagle.* She was eventually sold in 1853. An earlier *Adventure* sailed with the *Resolution* on Cook's second voyage in 1772–75. The illustration, showing the ship in Messina Strait, is from a view in the Hydrographic Department's archives.

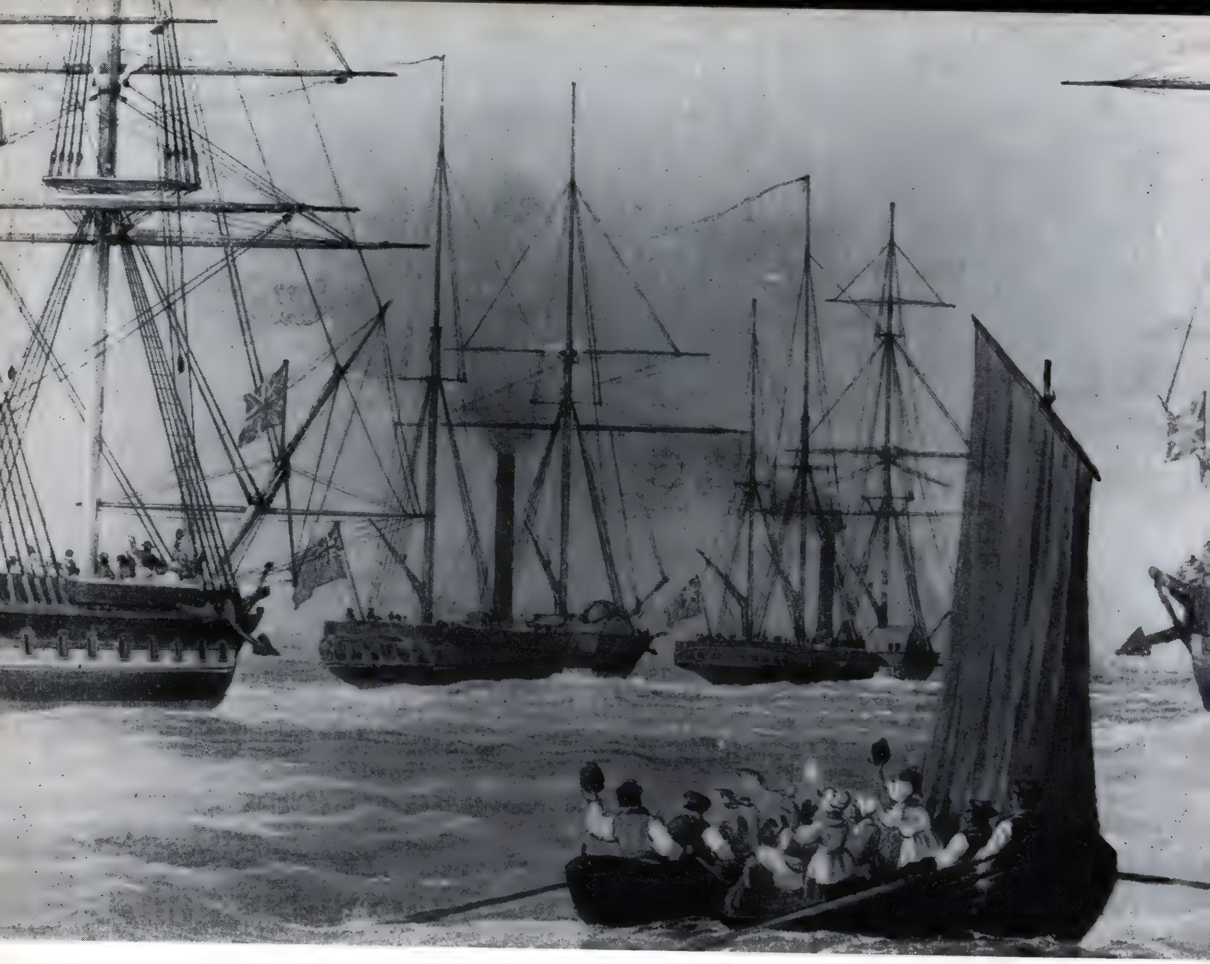
3. 1831–1840. *Fairy,* length 90 ft, beam 25 ft, 233 tons, complement 50. Launched at Chatham in 1826 for surveying duty, *Fairy* was not commissioned as such until 1831. She succeeded the *Protector* which had been the principal ship in home waters, mainly on the east coast, under Hewitt since 1818. Continuing Hewitt's extensive surveys of the North Sea, begun in 1830, the *Fairy* met with disaster in November 1840 when she was lost with all hands in a gale off the Suffolk coast. No illustration of the ship has been found but part of a draught of a sister ship, the *Cadmus,* is reproduced here. *By permission of the Trustees of the National Maritime Museum.*





4a. 1825–1843. *Beagle*, length 90 ft, beam 24 ft, 235 tons, complement 58–65. Built as a sloop, rigged as a brig, at Woolwich in 1820, the *Beagle* was allocated to surveying in 1825 when she was sheathed and coppered at the same yard. She was employed in Magellan Strait under the orders of King in the *Adventure*, being commanded by P. Stokes until 1827 and then Fitzroy, with whom Darwin embarked for the famous South American cruise from 1831 to 1836. In 1837 the *Beagle* sailed for Australian surveys with Wickham in command until 1841, and J. L. Stokes until 1843. Paid off in 1843, the *Beagle* became two years later a watch vessel at Southend and later Paglesham under the Commissioner of Customs, and was sold in 1870. The illustration shows the ship at Sydney in April 1841, and is from a watercolour by Owen Stanley, then commanding H.M.S. *Britomart*. *By permission of the Trustees of the National Maritime Museum.*

4b. 1826–1848. *Mastiff*, length 84 ft, beam 22 ft, 184 tons, complement 44. Launched at Bideford in 1813 as a brig sloop, the *Mastiff* was the successor to the *Adventure* on Mediterranean surveys from 1826 to 1836 under Copeland and then Graves. Returning home, she relieved the *Investigator* in the Orkneys, and when Thomas died in 1846, Becher took command during one of his brief absences from his long service in the department in order to complete in 1847–48 the Orkneys survey. No illustration of the *Mastiff* has been found but she was doubtless similar to the *Beagle*. She was broken up at Woolwich in 1851. Her name seems to have been used for the vessel hired by the party surveying Scottish waters from 1849 to 1864 under F. W. L. Thomas who had served with his father in the *Investigator* and the *Mastiff*.

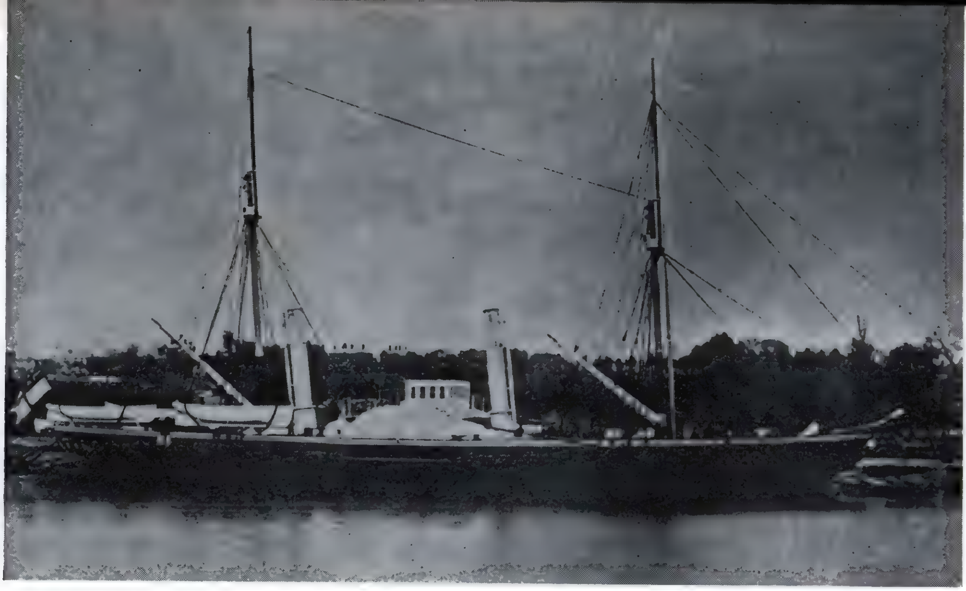


5. 1841–1847. *Shearwater*, 328 tons, 160 h.p., complement 50. Built at Harwich in 1826 as a paddle-wheel steam gun-vessel, named *Dolphin*, for the Post Office packet service, the *Shearwater* became an Admiralty vessel in 1837 on the mail steam-packet service from Liverpool. From 1841 to 1846 she was allocated to surveying as successor to the *Fairy* and was the principal surveying ship in home waters under the command of Washington until 1843 and then Robinson. The illustration shows her immediately ahead of the *Royal George* when Queen Victoria visited Edinburgh in 1842 and is part of a water-colour. In 1847 together with other steam surveying vessels, the *Shearwater* was needed for the relief of famine in Ireland and thereafter she continued in general service as tender to the Mediterranean flagship until sold at Malta in 1857.

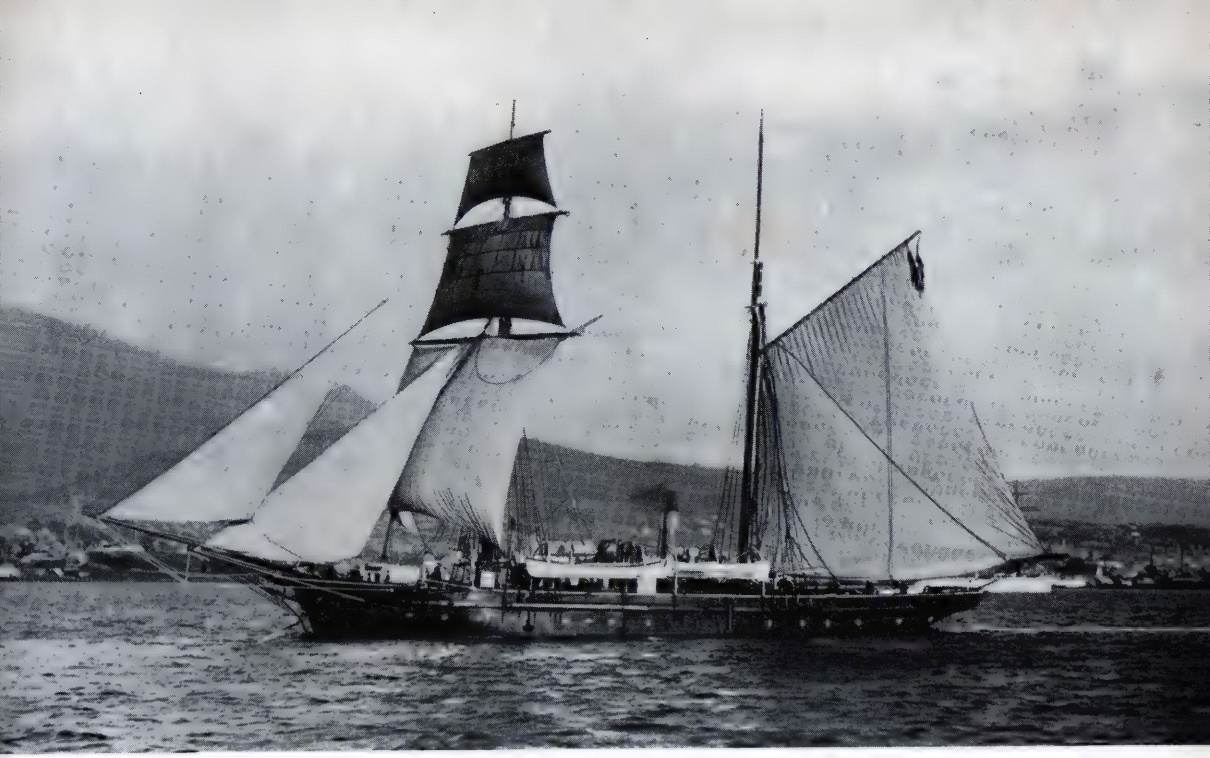
A second *Shearwater*, 913 tons and 532 h.p., Pembroke 1861, was stationed in the Pacific until 1869 and became a surveying vessel from 1871 to 1875. Sailing for the Mediterranean in 1870 under Nares, as a successor to the *Newport*, she made some observations of Gibraltar Strait currents in continuation of work begun by Dr Carpenter in the *Porcupine*, and then various surveys of the Dardanelles, Sicily, and Port Said with Wharton succeeding Nares in 1872. This *Shearwater* went next to the Zanzibar coast in 1873 and in 1874 carried transit-of-Venus observers to Rodriguez, using the opportunity to make a survey in the Seychelles. She ended her days at Sheerness in 1876, when Wharton transferred to *Fawn* for a continuation of Red Sea surveys. *By permission of the Trustees of the National Maritime Museum.*

6. 1845–1860. *Herald*, length 113 ft, beam 31 ft, 500 tons, complement 125–160. Built at Cochin in 1820 as H.M.S. *Termagant*, a sloop sixth-rate, the *Herald* was so named on conversion to a yacht in 1824. In this role she carried the Bishops of Barbados and Jamaica to their respective sees in 1824–26, returning from Havana with upwards of a million dollars embarked; she then took the Marquess of Hastings to Malta. After general service in the East, including presence at the proclamation of New Zealand's accession to the Empire in 1840 and in operations in the Canton River, the *Herald* was allocated to surveying in 1845. Under Kellett she sailed round Cape Horn, and for six years made surveys of the Pacific coast of America from Chile northwards. Her voyages included those through Bering Strait in the search for Franklin. The illustration shows her in that strait with the *Plover*, *circa* 1851, and is reproduced from a lithograph in *Euryalus, Tales of the Sea*, Chimmo, 1862.

In 1852 the *Herald* was recommissioned by Denham and sailed round the Cape of Good Hope to undertake surveys in the South Pacific, chiefly of the Fiji group, with the *Torch* as tender. These surveys continued until 1860, and before returning home, Denham had been largely responsible for organizing the coastal surveys of the Australian States in schooners such as the *Meda*. The *Herald* became the chapel ship at Shoreham in 1861 but was sold a year later to the ship-breakers after forty years' service. *By permission of the Trustees of the National Maritime Museum.*

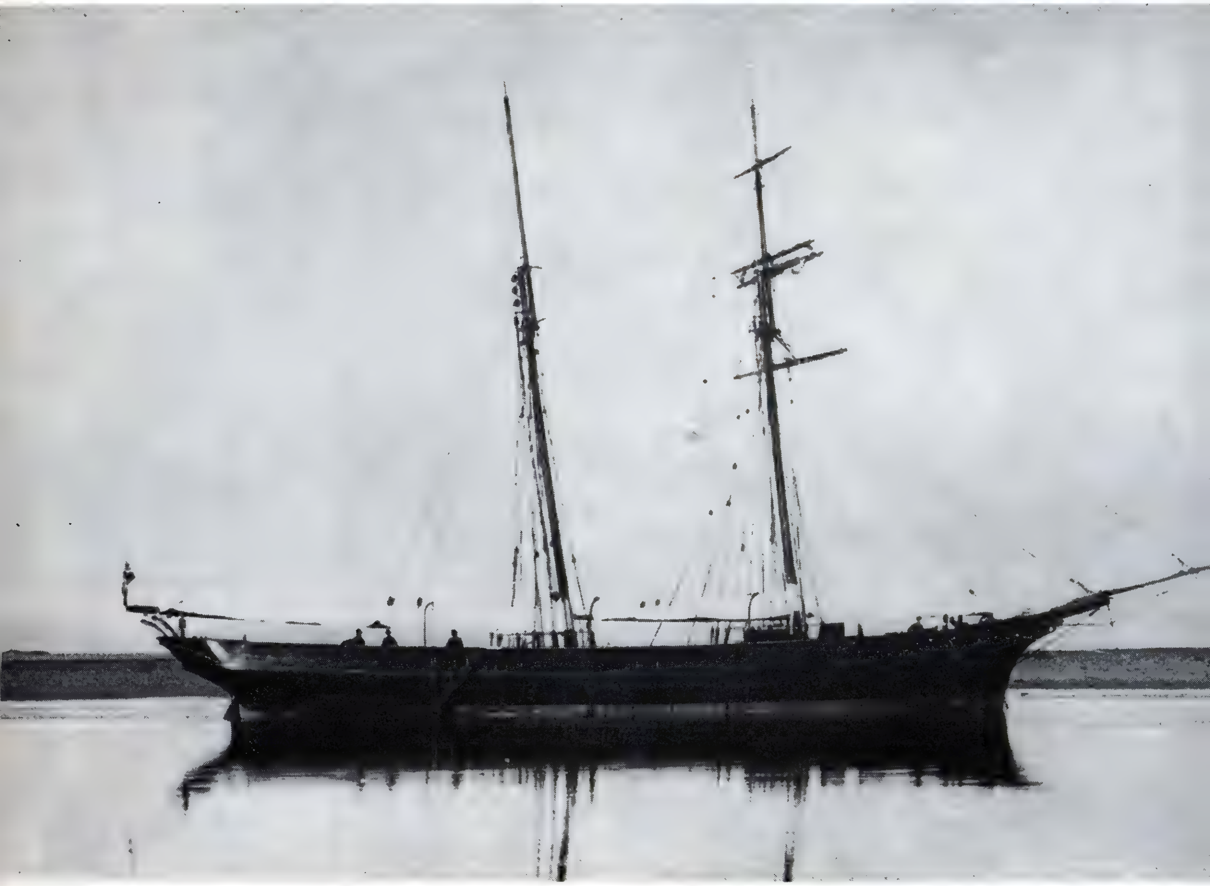


7. 1844–1881. *Porcupine*, about 350 tons, 140 h.p., complement 45. Launched at Deptford in 1844 as a paddle-steam gun-vessel for surveying duty, the *Porcupine* took up surveys in the Thames estuary under Bullock, but in 1847, like the *Shearwater*, she was required for the relief of famine on the coasts of Ireland. In the Crimean war she was under Otter for distinguished service with the Fleet in the Baltic and in 1854 she returned to surveys in Scottish waters, with a diversion to attend the laying of the first Atlantic cable in 1858. The *Porcupine* was the principal surveying vessel in home waters for many years, spending much time on the east coast, under Calver from 1863 and Parsons from 1872, with the *Lightning*, a similar vessel, joining her from 1865 to 1867. In 1881, thirty-seven years after her launching, the *Porcupine* was struck off the list and succeeded by the *Triton*. The illustration is from a photograph in the Hydrographic Department.

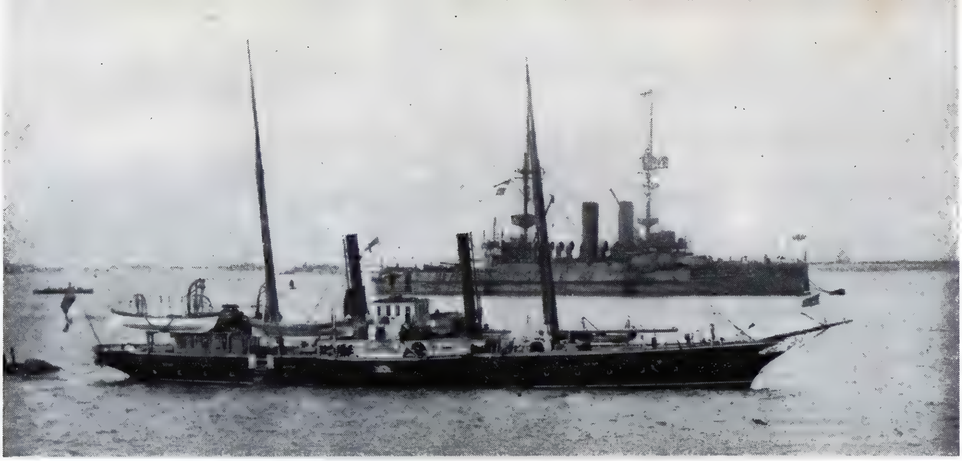


9. 1880–1887. *Flying Fish,* 940 tons, 840 i.h.p., complement 113. Built in Chatham in 1873 as a screw sloop with four guns, the *Flying Fish* was on general service in the East Indies until 1880 when she was allocated to surveying. She then succeeded *Sylvia* in China and Japan and under Hoskyn sailed from home via the Suez Canal, examining the South Arabian coast on passage. In 1881 the *Flying Fish* was first on the north-east coast of Borneo, and in 1882 she visited Seoul, where an important report was made, before starting surveys of the Korean coast, which continued for two years, Maclear succeeding Hoskyn in 1884. In 1885, during a period of strained relations with Russia, the *Flying Fish* was converted into an armed man-of-war, but after three months resumed surveying in the Eastern Archipelago for the benefit of trade between China and Australia. In 1886 she was succeeded by the *Egeria,* Aldrych, and on her way home to be paid off into reserve, she made surveys in the Indian Ocean and the Red Sea. The illustration is from a photograph in the Hydrographic Department.

Opposite. **8.** 1866–1878. *Nassau,* length 185 ft, beam 28 ft, 695 tons, 150 h.p., complement 110. Built at Pembroke in 1866 as a screw gun-vessel, first-class, the *Nassau* sailed that year as a surveying vessel under Mayne for the Magellan Strait. Returning home in 1869, she sailed the following year under Chimmo for the China seas, succeeding the *Rifleman,* Reed. Deep soundings were taken from Ceylon to Java and thence to Hong Kong, followed by work in the Sulu Sea which had to be broken off in 1872 owing to hostilities with the Sultan of Sulu. After a refit in Malta, the *Nassau* came under the command of Gray, who had been Chimmo's senior assistant and who was transferred from master to the Lieutenants' List for beating off an attack on his boat by Malays in Dalrymple Harbour, Sulu Island. A survey of Perim and deep soundings to Zanzibar were introductory to two years' work on the east coast of Africa, during which the *Nassau* took part in the reduction of a fort which led to the surrender of the Sultan of Zanzibar, negotiated by Gray. At the end of 1875 Gray contracted fever and was buried at sea off the Natal coast; before the news of his death reached England his promotion to commander had been announced. Napier succeeded Gray, and the *Nassau* continued with surveys of Malacca Strait and the China coast until succeeded by the *Magpie* in 1878. The illustration of the *Nassau* in Magellan Strait is reproduced from a water-colour by Vereker. *By permission of the Hydrographer of the Navy.*



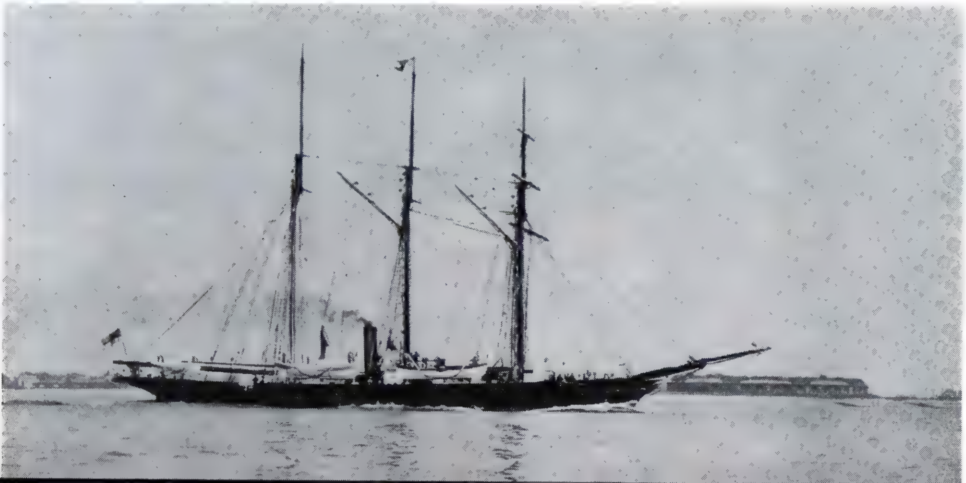
10. 1881–1887. *Lark*, 180 tons, complement 20–35. The *Lark* and her sister vessel *Meda* were surveying sailing-schooners built in England in 1879–80. As late as 1881, the Hydrographer referred to such vessels as useful and serviceable, inferring economy and absence of fuelling problems. Archdeacon sailed the *Meda* from England in February 1880, and six months later was at work in Western Australia where the *Meda* continued, later under Coghlan, until 1886 when it was decided that a steam vessel was necessary. The *Lark* commenced her career in the Solomon Islands in 1882 under Oldham and later Pullen; and she continued in these waters, including New Guinea, until 1887 when she was condemned as unseaworthy. There had been other smaller schooners in these seas, such as the *Alacrity*, the *Renard*, and the *Sandfly*, while in the West Indies, the *Sparrowhawk*, 86 tons bought in 1877, carried on until 1899 to be the last of the sailing vessels used for surveying. An earlier surveying schooner, the *Lark*, was tender to the *Thunder*, and in 1838 under Smith rode out a ‘ fearful ’ hurricane on the Great Bahama Bank, her log-book being used for the Admiralty pamphlet on revolving storms. (Dawson, *Memoirs of Hydrography*, Part II.) The illustration is from a photograph in the Hydrographic Department.



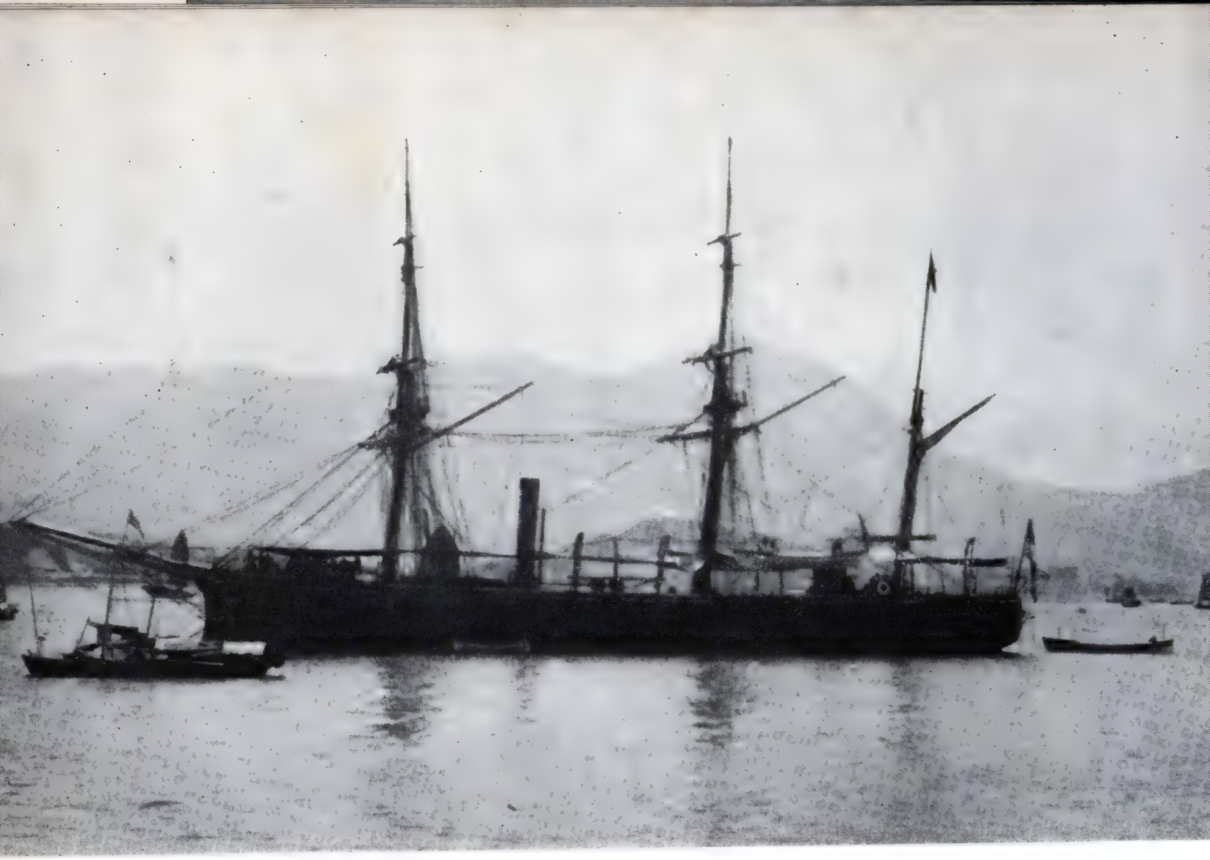
11. 1882–1914. *Triton*, length 145 ft, beam 23 ft, 410 tons, 370 i.h.p., complement 40. Built at Poplar in 1882 as a composite paddle-wheel surveying vessel, the *Triton* succeeded the *Porcupine* as the principal ship in home waters and was mostly employed on the east coast of England. Tizard commissioned her and remained in command until 1891. Later commanding officers were W. F. Maxwell, G. E. Richards, Pirie, Richards again, Purey-Cust, Pudsey Dawson, and Penfold until 1914 when on the outbreak of war normal surveying operations ceased.

Thereafter, the *Triton* filled various roles as a training-ship, being moored from 1930 to 1961 in the West India Docks under the National Sea Training Schools. Her hull was still sound when she left for ship breakers in Belgium. The illustration shows her in her heyday, about 1907, lying at Sheerness with H.M.S. *Bulwark* in the background. She carried the first steam whaler, which is just visible lying astern. *By permission of the Trustees of the National Maritime Museum.*

12. 1894–1912. *Waterwitch*, length 150 ft, beam 26 ft, 620 tons, 450 h.p., complement 76. Formerly the steam yacht *Lancashire Witch*, the *Waterwitch* was commissioned by Combe in 1894 for service on the Australia Station and did various surveys on passage out via the Cape. Her work included the Fiji Islands, Tasman Peninsula and Esperance Bay with lines of soundings run for telegraph cables. In 1897 under Pudsey Dawson the *Waterwitch* was transferred to the China Station working from Hong Kong to Weihaiwei for ten years under the successive command of Lyne, Hardy, and Glennie. In 1908 under Douglas she took up surveys of the Straits Settlements including Singapore Strait, and there she remained, later under Hancock and Reyne, until 1912 when she was rammed and sunk at anchor in Singapore Roads by the colonial Government yacht *Seamew*. The illustration of this handsome vessel is from a photograph in the Hydrographic Department.

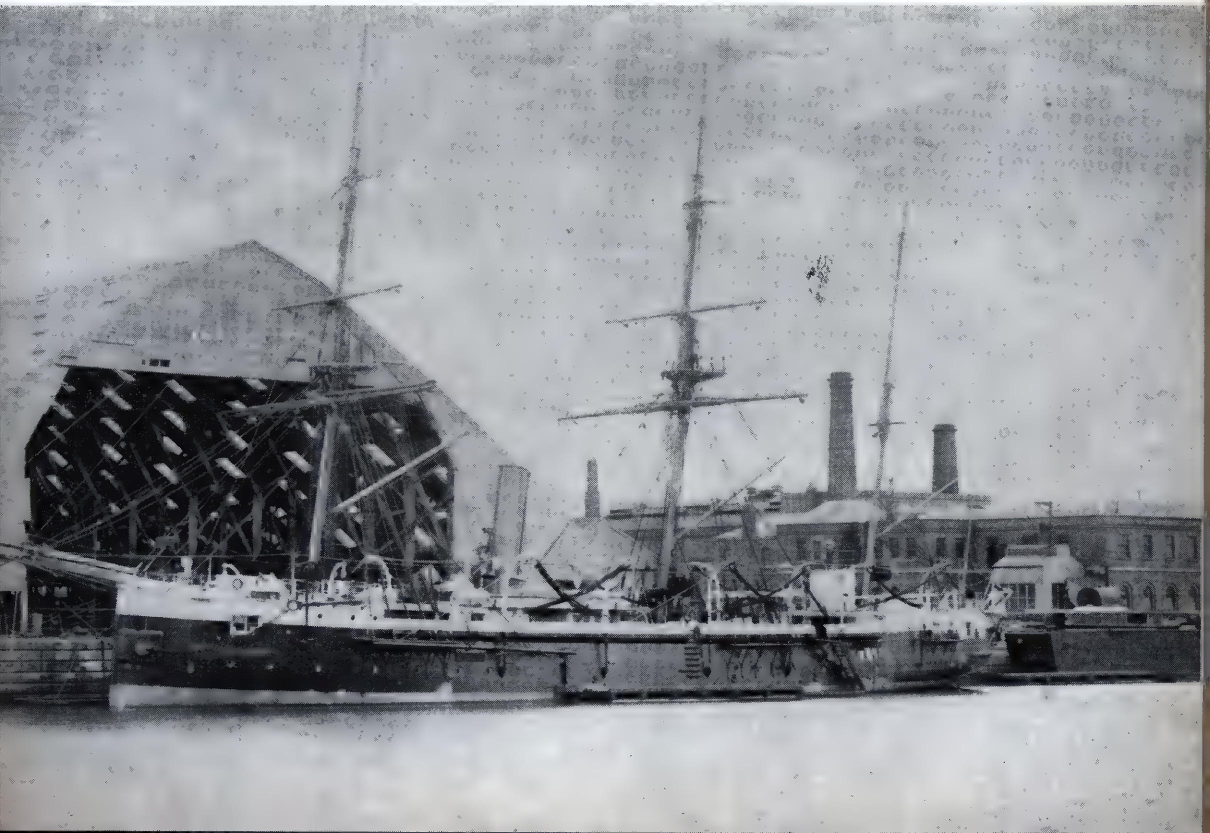


13. 1907–1923. *Fantôme*, length 185 ft, beam 33 ft, 1 070 tons, 1 400 h.p., complement 139. Built at Sheerness and launched in 1901 the *Fantôme* was on the America and West Indies Station until 1905, taking part in the Anglo-German blockade of the Venezuelan coast. She was then, together with similar ships, the *Merlin* and the *Mutine*, adapted for surveying in 1906–7; and these three ships replaced the *Rambler*, *Goldfinch*, and *Penguin*. The *Fantôme* was commissioned by Hardy in 1907 for the Australia Station, and on passage via Suez she surveyed Jubal Strait. Until the outbreak of the 1914–18 war she was chiefly on the north-west coast of Australia and alternatively in Tasmania. In 1909 under Pasco she surveyed Cartier Island off northern Australia and formally annexed it to the Crown, this being the last of several annexations made by surveying ships in this era. Pasco was succeeded by Nares in 1911 and the latter by Reyne in 1913. In September 1914 the *Fantôme* was with the Australian Navy, paid off at Sydney and lent to the Commonwealth Navy Board until 1919. In that year she was reconditioned as a surveying ship and in 1920 took up her main task of surveying Torres Strait, Maxwell succeeding Scott in 1921. In 1923–24 the *Fantôme*, *Mutine*, and *Merlin* were unfit for further service and were succeeded by the *Herald*, *Ormonde*, and *Iroquois*. The photograph shows the *Merlin* in the Far East dressed over all. *By permission of the Trustees of the National Maritime Museum.*



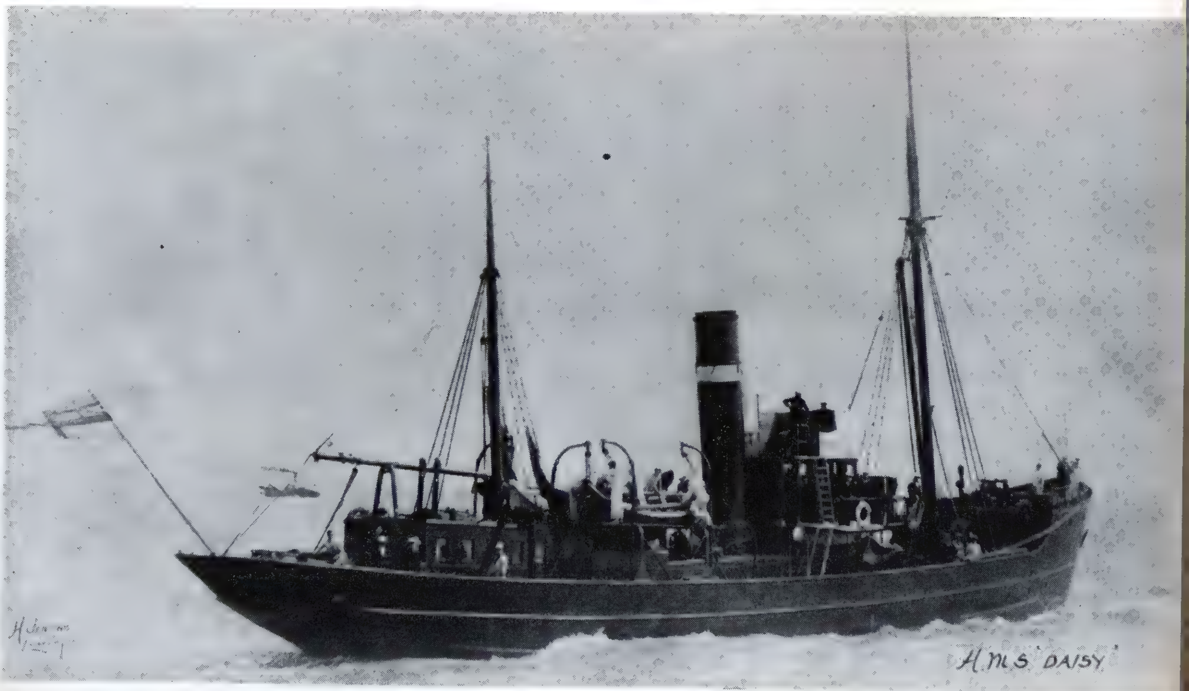
14. 1882–1904. *Dart*, length 133 ft, beam 25 ft, 472 tons, 200 i.h.p., complement 67. Originally a steam-screw yacht, the *Dart* was commissioned by Moore in 1882 for general service on the Australia Station, but carried out surveys as opportunity offered. In 1885 Field recommissioned her for surveying duty and in that year discovered and named Dart Reef in 17°21′S, 148°14′E. *Dart*'s surveys ranged from New Guinea, the New Hebrides, the Solomon Islands, and Queensland inner route to Tasmania in the days when friendly relations with the natives needed establishing. Besides Field, she was commanded by two other future Hydrographers, Purey-Cust 1892–95 and Parry 1898–99. In Parry's time coconuts were successfully planted on islands bordering the inner route off Queensland to aid navigation or shipwrecked mariners. In 1903, after eighteen years' service, the *Dart* was found unseaworthy for the Solomon Islands and did a final year on the inner route. The illustration is from a photograph in the Hydrographic Department.

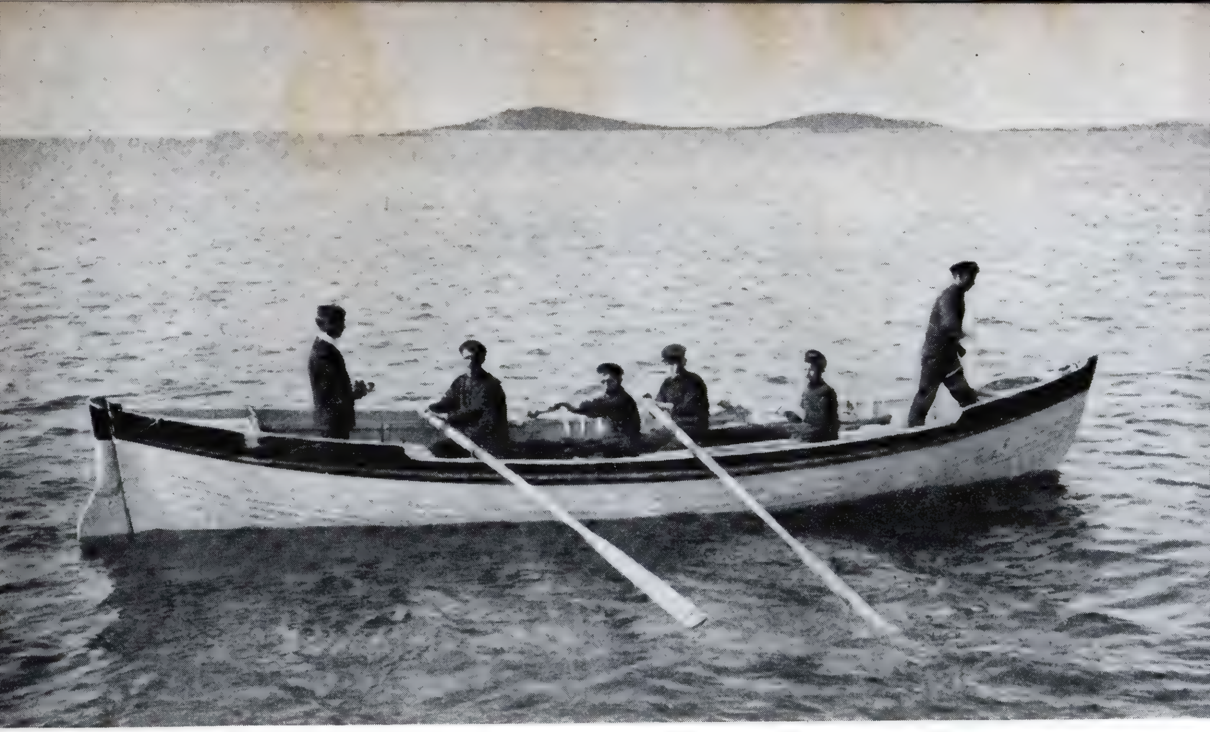
15. 1884–1906. *Rambler*, length 157 ft, beam 29 ft, 835 tons, 690 h.p., complement 113. Built at Glasgow and launched in January 1880 the *Rambler* saw service on the Cape, West Africa, and South America Stations. In 1884 she was selected to succeed the *Magpie* as the surveying ship on the China Station, and left England in January 1885 under Vereker. Her first cruise, a remarkable one, included surveys at Malta, in the Red Sea, and Diego Garcia, a chain of meridian distances from Plymouth to Hong Kong, fixing salient points between Hong Kong and Shanghai, followed by surveys of Haitan Island, and, finally, at the end of the year, Hong Kong Harbour. From 1886 to 1891 under Moore and Dawson the *Rambler* surveyed on the coasts of China, Borneo, and north-west Australia. She returned home in 1891 and was out of commission for three years. From 1895 to 1900, commanded successively by Richards and Purey-Cust she surveyed on the west coast of Africa, the east coast of North America, and the West Indies; and in the last year rounded the Cape for a cruise up the east coast of Africa and the Red Sea. The *Rambler* recommissioned at Malta in 1901 and was then on the China and Borneo coasts under Smyth and Monro until 1906 when she was stripped and paid off at Hong Kong. She had lived up to her name for twenty-six years. The photograph shows her lying in Chatham Dockyard. *By permission of the Trustees of the National Maritime Museum.*



Opposite. **16.** 1913–1940. *Endeavour,* length 200 ft, beam 34 ft, 1 280 tons, 1 300 h.p., complement 125. Designed and built for surveying on the Clyde, the *Endeavour* relied on the new anti-fouling composition and was not sheathed. She was commissioned by Hardy in 1913 but next year changed crews with the *Hearty,* Learmonth, her surveys being of the North Sea banks until war broke out. In 1915 on a request by the Commander-in-Chief, Eastern Mediterranean, the *Endeavour* was sent to join his flag equipped with lithographic presses for chart production, and under Edgell was engaged on Dardanelles operations. From 1916 to 1918 she surveyed various Mediterranean Fleet harbours; Hancock succeeded Edgell in 1917 but lost his life on detached war service in 1918. After the war the *Endeavour* took up a survey of the north coast of Egypt, and for the next fifteen years was either in the eastern Mediterranean and the Red Sea or on the west coast of Africa under the successive commands of Reyne, 1921 Geary Hill, 1927 Law, 1930 Edgell, 1931 Rice, 1933 Southern. From 1933 to 1935 her scene of operations was Malaya and the west coast of Siam; and in 1936 the Arabian coast and the Gulf of Aden. In 1937 she commenced surveys of the New Zealand coasts under Wyatt, and when the Second World War intervened she was paid off at Singapore. In 1942 the *Endeavour* reappeared at Aden manned by survivors from H.M. Ships *Prince of Wales* and *Repulse,* and for a year under E. H. B. Baker resumed surveying for naval operations in the Red Sea. In 1943 she was paid off at Suez to end her naval life as an accommodation ship and in 1946 she was sold to a Greek shipping line to ply the eastern Mediterranean a while longer. The illustration is from a photograph taken at Malta and is in the Hydrographic Department's archives.

17. 1912–1920. *Daisy* and *Esther,* 450 tons, 500 i.h.p., complement 33. These two trawlers were specially built at Aberdeen for the surveys of the North Sea banks and under Geary Hill and Peebles operated with the *Endeavour* from 1912 until war broke out. They were then appropriated for minesweeping, but in 1916 returned to surveying and for four years did useful work on the east coast in connexion with naval operations, much of it in Dover Command. The *Daisy* was commanded by Comber, J. M. Jackson who died on board, and Harvey; and the *Esther* by Maxwell, Scott and Knowles. Both vessels were paid off in 1919–20. This photograph of the *Daisy* is from the Hydrographic Department's collection.





18. Boat Sounding. These two illustrations show the types of boat carried in surveying ships for sounding in shallow water.

The whaler under oars was carried in the *Gladiator*, employed in home waters from 1894 to 1907. It is difficult nowadays to appreciate the manual labour expended over the years until a steamboat was first carried in the *Triton* at the beginning of the twentieth century.

The steam cutter illustrated was one of two carried in the *Endeavour* in 1920 and is from a photograph by the author. The leadsmen stood at the level of the gunwale in two chains rigged on each side of the boat abreast the engine-room. An expert seaman could heave the lead sufficiently far ahead to obtain soundings in as much as ten fathoms with the engine running at its slowest speed.

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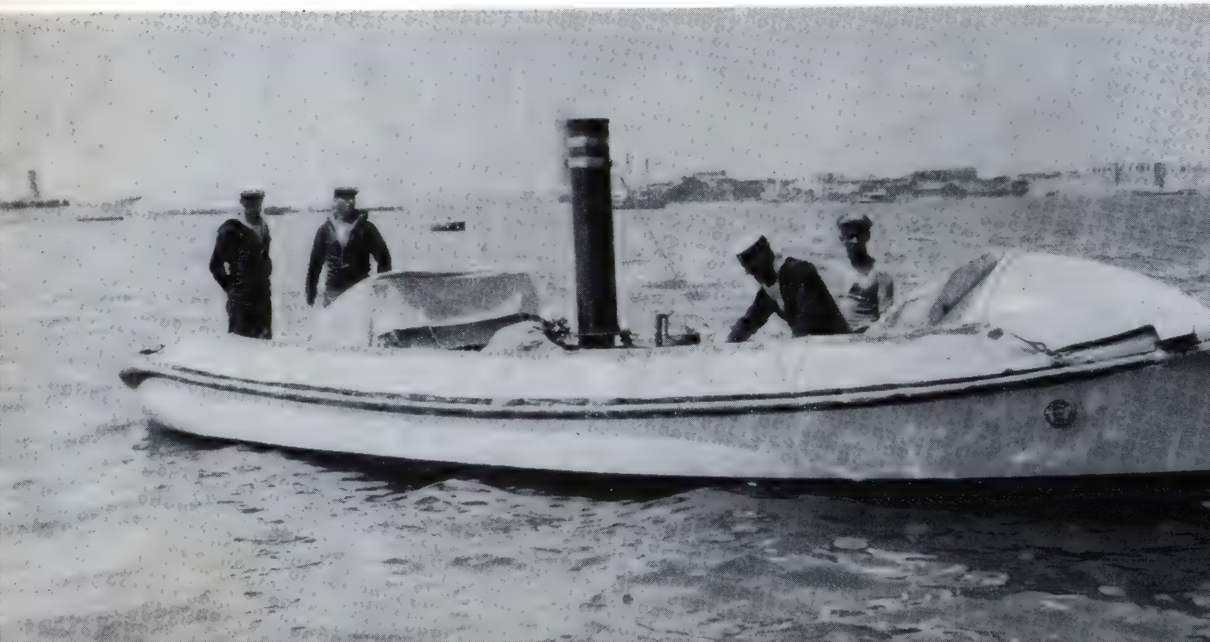

On orthography, in a letter in 1885 to Maclear about Korean names in particular, Wharton referred to ' the method of Admiral Washington ', saying, '. . . I am most anxious to adhere to [it] closely especially in any names which we introduce on to our charts for the first time. I am hoping to get the Geographical Society to adopt our system and if that can be arranged I hope all map-makers may follow and in about two hundred years or so we may hope to get things a little straight '. In 1886 he wrote that accents were objectionable, the acute accent being the sole exception; and the subject as well as instructions for writing Sailing Directions are referred to later in connexion with a new edition of *General Instructions for Hydrographic Surveyors.*

A notable addition to the department's publications was the first edition of *Ocean Passages for the World* in 1895.

Light Lists were recompiled into seven books instead of ten in 1885, but ten years later increased to eight. In 1893 Wharton attended a conference in Washington on the classification and efficiency of lighthouses into which electricity was being introduced; and the recommendations were embodied in the Admiralty Light Lists. The inclusion of drawings of lighthouses was resisted in 1901. In the next year details of wireless-telegraphy stations were given.

One book of Tide Tables continued to suffice for predictions at ports at home and abroad. In 1894 there was mention of the completion of a series of hourly tidal-stream observations by Trinity House light-vessels, and in 1898 C. H. Simpson was appointed to the department for one year to compile the results. A year later three atlases, each containing twelve charts, were published for the English and Irish Channels, the North Sea, and the coasts of Scotland.

The Hydrographer, under his Instructions, continued to superintend examinations in pilotage and to advise the Board on all navigational matters. Until 1902, boards for the former consisted of two officers of the department and one navigating officer from a home port. They met for four or five days nine times a year; and to reduce the load on the department's officers, Wharton obtained approval for a board of two, which, though a departure from tradition, was, he thought, acceptable and in the candidate's favour. In 1895 the Hydrographer urged that midshipmen should have more instruction in navigational appliances, and in 1903 that warrant-officers should have instruction at the Navigational School because of the increasing number of small craft in service.

In 1900, courses for the examination in pilotage were transferred from Portsmouth to the Royal Naval College, Greenwich, but in 1906 returned to the Navigation School, which then took over the examinations also. Meanwhile, in 1903, Captain H. F. Oliver had commissioned H.M.S. *Mercury* as the school and begun qualifying (N) courses. In 1906 the school reoccupied the old Portsmouth College building and the tender *Dryad* was adopted as the name ship.

In 1889 a new publication, *Notes bearing on the Navigation of H.M. Ships*, was issued by the Hydrographic Office with the authority of the Lords Commissioners. It covered ' points in connection with Navigation on which there may be misapprehension ', which had not been authoritatively published previously and which were not suitable for incorporation in Admiralty Instructions. There were sections on the corrections of charts, Light Lists, and Sailing Directions; the use of charts as navigational aids; patent logs and sounding-machines; making plans of bays and harbours; the sextant and its centring error; chronometers; the Remark Book and compass journal.

The techniques and equipment of the day are of interest. For example, the first section described the correctional arrangement in detail and stressed that in all cases where charts and Sailing Directions differed the former must be taken as the guide. The second section mentioned means of assessing a chart's accuracy by the date of the survey and by the fullness or scarcity of the soundings; the five-fathom line as the danger-line; chart distortion; and the risk in using small-scale charts. In the paragraphs on fixing position, the advantages of the sextant and station-pointer were emphasized, the latter now being supplied to all ships:

> It will readily be seen that in wartime, when the compass may be knocked away or rifle-fire may make it undesirable to expose the person more than necessary, a sextant offers great advantages, as angles can be obtained from any position whence the objects are visible. It is this contingency that makes it especially desirable that all navigating officers should become expert in this method of fixing a ship's position. It is not intended that the use of the compass should be given up. . . .

It went on, however, with mention of the value of ' doubling the angle on the bow ' and ' four-point bearings ', and continued:

> The tripod now supplied to all ships to hold the lamp over the standard compass will be found of great service in fixing position at night, as by its aid a bearing can be as accurately taken as in daylight. Its use in connection with ascertaining the change of bearing of an approaching ship's light should not be forgotten.

For making astronomical observations, the Sumner-line method was recommended. A warning on changes of variation was included with the statement that compasses on the charts could not be re-engraved more often than for a change of a quarter of a point.

In the section on patent logs and sounding-machines, there were notes on harpoon and taffrail logs, and Massey's or Walker's machines. Burt's bag and nipper was said to be too little used though a simple and admirable contrivance. There was a description of inflating the bag and reeving the sounding-line through the nipper attached to it so that it ran until, on the lead reaching the bottom immediately below it, a spring restrained the line. Meanwhile, the ship had to be held stationary close by.

The introduction of the Thomson sounding-machine followed, and an

Admiralty memorandum of October 1885 was reproduced in full describing the legitimate use of it as well as the precautions to be taken, e.g. none of H.M. ships were, unless under special orders, justified in running for the land in thick weather, relying on this machine as an unerring guide.

For the making of plans and the like, Hull's *Practical Nautical Surveying*, which was in the ships' libraries, was recommended. The use of Remark Books and Hydrographic Notes for keeping information up to date was stressed in the final section.

New editions of *Notes bearing on the Navigation of H.M. Ships* were in 1891–92 and 1893; the fifth edition is missing, and the sixth was in 1909. As later described the *Notes* thereafter became embodied in Sailing Directions. Between 1891 and 1893 the additions were that the chart on the largest scale was always to be used, and ' instead of considering a coast to be clear unless it is shown to be foul, the contrary should be assumed '. Also added were sections on the use of oil for modifying waves, local magnetic disturbances, and the unreliability of buoys. Harpoon logs and Burt's bag were omitted in 1909.

A large number of minutes concerned cases of grounding or collision. In 1893 Wharton could not agree that, as the result of one court martial, charts should carry a caution, ' Not to be considered reliable '. In a contemporary letter he wrote: ' Charts are looked on as infallible despite all one can say.'

From 1890 onwards the subject of navigational aids in war received attention. The Hydrographer insisted that any arrangements must be with the concurrence of the senior naval officer of the station; and he drafted instructions in 1893 for distribution to British consuls through the Director of Naval Intelligence. Details of the defences of ports at home and abroad were referred to the Hydrographer for comment, but Wharton avoided membership of a committee on the subject in 1891. In 1898 the Hydrographer was required to submit proposals for the routing of merchant ships in war and expressed the view that little was needful beyond listing the protected ports, with a warning that such as Berehaven should not be used until charts and pilots became available.

Among the many defensive measures on which the Hydrographer advised was the protection of harbours by defensive minefields. Wharton held strong views on this subject, and in 1900 he minuted: 'I trust the minefields at Portsmouth will never be permitted to be laid, except in the case of serious defeat of our Fleets, believing as I do that they will only bring inconvenience and probably disaster to our own ships.' In the same year there was the Committee on the Control of Telegraphic Communications in War, which considered the possibility of cutting an enemy's cables.

In 1903, Somerville was specially attached to H.M.S. *Sphinx* in the Persian Gulf to obtain information of places on the Persian shore having potentialities as enemy naval bases. In 1904, the year in which the Committee for Imperial Defence was formed, there was the first boom across the Medway and plans for routing transports to India in the event of war with France and Russia, when, moreover, the operations of surveying ships were to be taken out of the Hydrographer's control. They were to be paid off or used by commanders-in-chief abroad.

The harbours that continued to be an Admiralty responsibility after the Transfer Act of 1862 caused much departmental work in advising on moorings, navigational aids, and so on; and the extent of Admiralty responsibility had again to be argued with the Board of Trade. At long last there were final proposals submitted by Coode, Son & Matthews in 1897 for enclosing Dover Harbour with breakwaters. Wharton was on a small committee of the Admiralty, the Board of Trade, and the War Office to further the project, though it was to be twelve years before its completion. Advice was given on an Order in Council and on the appointment of an acting King's Harbour-master in 1904, as well as a change in command limits so that Dover fell in Nore Command, whence dockyard facilities for moorings and the like could be more easily provided. Earlier, in 1901, similar advice was given for Berehaven, and also in respect of a site for a dockyard in the Firth of Forth. In 1902 Tizard was sent to examine the possibilities of a harbour on the east side of Gibraltar.

In the Compass Department, Mayes was succeeded as superintendent in 1887 by his assistant Creak, who was in turn succeeded by Henderson in 1901. An additional officer was obtained by the Hydrographer in 1903, making three and the examiner at Deptford. The Thomson compass continued in competition with the Admiralty liquid, and in 1899 the Board preferred to accept comments from afloat favourable to the former rather than to set up another committee. Later, the Admiralty liquid compass was shown to have advantages under conditions of heavy gun-fire. An Austrian (Peichl) compass in 1901 was among others given trials. Dent's was the best of three boat's compasses tried at *Vernon* in 1891. Much thought was given to the lighting of compasses by electricity and to the effect of modern motors and dynamos. In 1900 the Hydrographer recommended that the steel bands in seamen's caps should be discontinued!

On other navigational equipment, the records show continuing trials of Walker and Massey logs and Thomson and Bassnett sounding-machines. In 1903 a major development occurred whereby an improved Thomson (Kelvin and White) machine was fitted abreast the bridge with a dial visible from above. A good leading block was an important item; stranded wire was used, as were Field's tables for sounding without tubes, constructed after experiments in the *Research* in 1903. The light boom and outhaul for the block were to be made on board. Other designs had been tried, such as an ingenious proposal from Cooper and Wiggell in 1888 that advocated the use of a bar-lead, which contained a mechanism worked by hydrostatic pressure and recorded electrically on board; but the Hydrographer considered that any advantages would not compensate for the great chance of its getting out of order. Two years later, gunpowder explosions listened to with a submerged ear-trumpet were suggested. Galvanized wire made its debut in 1886, with trials of a supply from W. Smith & Son of Warrington. Also for surveying there were improved models of the Lucas sounding-machine, and in 1890 the submarine sentry was adopted. There were various automatic tide-gauges, a self-registering one being established on Admiralty Pier, Dover, in 1902.

Regarding the Royal Observatory, Greenwich, and the Cape Observatory, the Hydrographer's Instructions called for advice in particular on their internal economy and the management of their staff. He was also to furnish information or opinion on scientific expeditions and scientific questions when he was able. Wharton's efforts on staff matters met with varying success. An establishment of computers was agreed in 1896. Navy Estimates showed an increase between 1890 and 1900 from £8 000 to £9 000 at the Royal Observatory and from £4 000 to £7 000 at the Cape. Some £1 000 per annum was specially allowed for the photographic mapping of the heavens during the period. The Hydrographer in 1889 thought that the Astronomer Royal's accounts should go *en bloc* to the Accountant-General, though he would endeavour to clarify any specific points. Chronometer and deck-watch supplies, and the accounting procedure for them, were revised from time to time. Electrically operated time-balls connected to the standard clock in the chart-and-chronometer depots came into use, e.g. Devonport 1885, Sheerness 1894.

There were frequent applications from the Royal Society for Admiralty assistance in transporting observers of eclipses to many parts of the world. In 1894 a Joint Permanent Eclipse Committee was formed by the Royal Society and the Royal Astronomical Society, and Hydrographers have continued to serve on this committee. Britain's membership of the International Geodetic Association appears to have caused some concern, and was decided against in 1887. Ten years later, when the Royal Society advocated membership, the Hydrographer advised the Treasury that it should not be charged to the Navy Vote.[1]

The Nautical Almanac Office was superintended by Downing until he retired in 1891, and then by Hind. The Prime Meridian Conference, which Evans had attended in Washington in 1884, and which established the Greenwich meridian internationally, had resolved that the astronomical day should be brought into line with the civil day. Opinion in Britain and the Colonies was favourable, provided that sufficient warning was given; and agreement seemed at one time to be in sight for a change at midnight on the last day of the nineteenth century. Soon, however, the Hydrographer had to inform the Board that international opinion was not unanimous, and in March 1897 the Board declared that it had no intention of reconsidering the matter until there was unanimity. In 1892, on a proposal from the Shipowners' Society, *The Nautical Almanac* was divided into two parts, Part I containing such data as was necessary for a large proportion of the mercantile marine. There were other improvements, and in 1903 the Hydrographer reported that a committee, of which H. F. Oliver was a member, had found in favour of abolishing the lunar-distance method of position-finding in view of the improvements in chronometers and charts.

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[1] The coordination of various international scientific societies, which originated in the later years of the nineteenth century, was the object of the International Association of Academies, founded in 1900. Its activities ended with the 1914-18 war.

Some other subjects may be mentioned. In 1887 Wharton negotiated with the committee formed for the late Admiral Sir Charles F. A. Shadwell's memorial fund. The committee having a medal in mind agreed, however, to a small sum of money for purchasing an instrument. The award, promulgated in *The Navy List*, was a testimonial for the most creditable plan sent in during the course of a year by an officer not higher in rank than lieutenant-commander, and who was not a surveyor. The plan was to be assessed by the Hydrographer, the Assistant Hydrographer, and the Superintendent of Charts; the prize was established in 1888. The first award was in 1889 to Lieutenant A. J. Hotham.

Early in 1889, the United States proposed an International Maritime Conference in Washington, and issued invitations through political channels. The agenda included regulations for preventing collisions; ships' seaworthiness, loading and designation; shipping lanes; storm-warnings; uniform buoyage; uniformity in Notices to Mariners; and the setting-up of a permanent commission. Wharton thought the agenda too widely drawn and insufficiently prepared. He went to a meeting with the First Lord in the House of Commons, following which the Admiralty and Board of Trade pressed the Foreign Office to seek limitation of the agenda to the collision regulations. On the last item, the Board expressed the view that any further conference should be held in England, 'the country undoubtedly most interested in maritime matters'. The upshot was that a delegation was sent to a conference deferred to the autumn, with instructions not to commit Britain. It included Rear-Admirals Molyneux and Bowden-Smith, Nares from the Board of Trade, two Merchant Navy captains, and Scott of the Meteorological Council. All subjects were discussed, but the proposal for a permanent body was dropped. In the following two years, Wharton was concerned in getting the proposed amendments to the collision regulations adopted; and Trinity House formed a committee on a universal-buoyage system.[1]

The Third International Maritime Conference was held in London, but as shown by the agenda for the first meeting, the Board of Trade rather than the Admiralty was concerned. Not until 1912 were hydrographic matters specifically discussed.[2]

In 1887 the use of oil to still the waves was mentioned in a minute and in a letter in which Wharton said he had been urging its use in the Fleet; there was also an Admiralty memorandum on the subject. In 1891 the Hydrographer was called upon to comment, first on a Channel bridge, and later on Sir E. J. Reed's tubular railway. On the former, he began: ' Being exposed in its whole length, there is probably no strategic objection to a bridge as there is to a tunnel—both ends of which being held the whole is in possession.' Using the Forth Bridge as an example he showed the hindrance to navigation from a line of obstructions, each with a fog-signal on it—' It is not easy to foresee which would be the worst, the confusion in calm weather from a large number of fog-signals within hearing, or the difficulties in heavy weather from the doubtful blasts which would reach the ear.' He spoke of construction and maintenance difficulties, and after referring to Britain's shipping interests he concluded: ' The feeling of the maritime nations of the North and Baltic Seas on the obstructing of the Channel through which their trade passes, for the benefit of certain individuals in England and France, and the consequent political bearing of the project, I merely indicate as another factor to be considered in deciding on the Government action.' On the tubular railway, the objections of an Admiralty/Board of Trade committee were that it would impede the flow of water by reducing by one-quarter the total depth in the part most used by shipping, and produce dangerous overfalls; the laying-plant would provide obstructions for many years; and the shallow ends would become covered by shingle, so that they could not be destroyed if this was desirable for defence reasons.

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[1] See p. 91.

[2] See p. 312.

In 1892 Wharton gave evidence before a committee on the Ordnance Survey. In 1895, hydrographic exhibits were arranged at the Sixth International Congress, London, and in 1900 at the Paris Exhibition where a Grand Prix diploma was gained. In 1904 Wharton was strongly against official representation at an international geographic congress in Washington, the resolutions of which were at present harmless and sometimes of service to geography. If an official of Great Britain was present, monetary aid might be asked and endless difficulties created while no good could possibly come of it.

In 1898 the Hydrographer was strongly urging that H.M. ships should still be exempt from light and harbour dues; and the Board supported him, adhering to their views of 1894–95 in the face of the suggestion that it would relieve the Merchant Navy. In the same year there was an echo from the past when the Colonial Office wanted to know the distance from Pitcairn Island to Fiji for the proposed transfer of Christian to stand trial for double murder. In 1901 the Hydrographer agreed with a Lloyd's proposal that the currents off Ushant should be observed by using floats thrown overboard from H.M. ships, adding that the practice of throwing bottles overboard every day[1] had been discontinued for many years.

Wharton continued to feel some responsibility for the Admiralty Library although it was not a charge to the Scientific Vote. He remarked in 1888, when Shortland started some research work, that Shortland would be lucky to find what he wanted, but Wharton was unsuccessful in his attempts to have a successor appointed for a copyist who had begun an index. The Board ruled that Sherington, the librarian, should compile the index and thereby gain a better knowledge of the library's contents. No decision seems to have been reached when in 1898 the Hydrographer proposed monthly lists of additions and eventually a new catalogue to replace that of 1875. At that date, the Hydrographer also recorded that hope had been abandoned of moving the library into proper accommodation in the new building.

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[1] See p. 57.

One of Wharton's last minutes in 1904 was an effort to obtain higher pay for captains in the department who, he said, were hard to obtain now that the old Navigating Branch was almost extinct. He also proposed that instead of his £1 000 per annum and half pay, his successor Field, who began to take over in March, should receive £1 500, which would bring him into line with the Directors of Naval Intelligence and Ordnance.

Progress of marine surveys

The cruises of the various surveying ships during the period were described in some detail, together with some particulars of the ships, in the Hydrographer's annual reports to Parliament; and a tabular digest of this information is given on pp. 166 to 205. A general description follows, preceded by some account of the increasing demands being made on the surveying service.

For instance, in 1890 the report mentioned a new danger off Anglesey and the discovery of Warden Bank in the Clyde; and Wharton said that the necessity for frequent and closer surveys of the shores of the United Kingdom was apparent. More generally, he instanced what remained to be discovered and charted in the waters of the globe of the most formidable dangers to navigation, viz. small submerged rocky patches, seventy-five of these and four sandbanks having been reported—nineteen through vessels striking them, and twenty-five by foreign Governments in whose waters they lay. Such figures were thereafter regularly included and those for 1901 were among the highest, i.e. no less than 315 rocks and shoals dangerous to navigation. Of these, forty-four were reported by surveying vessels, thirteen by other of H.M. ships, thirteen by various British and foreign vessels, twenty were discovered by vessels striking on them, and 220 were reported by colonial and foreign Governments. Another detail included from 1898 was the total work done by the surveying vessels in terms of coastline charted, 1 223 miles, and areas sounded, 4 654 square miles.

In 1892 the report commented:

> The necessity for resurveys of a more detailed character than the majority

> of those which, in the endeavour to provide fairly reliable guides of the whole world for seamen, have hitherto been made, becomes greater as the more general employment of steam encourages ships to enter narrow waters formerly inaccessible when the motive power was wind. Rocks are constantly discovered in such places, even when the survey has been apparently of sufficient completeness.

In 1895 there was a further comment:

> Requests for surveys of a more modern character continue to be received and are undoubtedly necessary to meet the requirements of the numerous large steam vessels which visit nearly every corner of the Globe; and the increasing traffic caused by the expansion of trade, in waters where but a few years ago hardly a vessel was to be met, demands in many cases detailed surveys on a large scale.

In October 1898 Wharton reported fully on the matter to the Senior Naval Lord. He gave a formidable list of surveys outstanding, some very necessary. In answer to the question ' How long would it take to survey such parts of the globe as the British Admiralty might fairly be expected to provide charts for? ' he replied he could not foresee that surveys for H.M. ships and British trade could *ever* come to an end. Having recapitulated what had been said in the annual reports mentioned, he added that he was very unwilling to order any but close surveys, which meant necessarily slow progress. As an example, the Queensland inner passage had been covered by the *Rattlesnake* in part of a season in 1848 but, since the loss of the *Quetta* in 1890, a steam surveying vessel had been working for eight years, and would require another twelve. In conclusion, Wharton preferred to say that as British influence extends, the surveys are likely to get further and further behind requirements; and he listed immediate work as Western Australia, the southern Red Sea and the Aden vicinity, parts of the western coasts of the Red Sea, the north and west coasts of Borneo, the coast of Labrador, the lower Canton River, British New Guinea, the British Solomons, the west coast of South America and the Patagonia Channel, though the last should be done by Chile.

It was no doubt in the light of these facts that in 1903, when the Governor-General of Australia asked for surveys on the north-west coast, which Wharton thought largely unjustified but would bear in mind, the Secretary of State for the Colonies was asked to consider ' whether it is not desirable to suggest to the Government of the Commonwealth that the institution of a marine-survey department would be greatly to their own interests, as it is impossible for the Admiralty to satisfy all the requests for surveys throughout the Empire '. This approach was followed up in 1904 after Wharton had seen the report of the Committee on the War in South Africa. The report's reference to a lack of good maps was seized upon by Wharton, who was then instructed to draft a letter in general terms on the institution of survey departments in the Colonies, the letter being sent in June 1904. In his comments Wharton mentioned his expectation that Canada would have been the first to do this, and indeed by 1905–6 matters were in hand under the direction of Mr W. J. Stewart, who had been appointed Chief Hydrographic Surveyor of Canada in 1904. Later developments in colonial surveys are given on p. 226.

Reverting to the minute of 1898, there was attached a historical list of past officers in charge of surveys, which, with a list of vessels filed in the previous July, were presumably the basis of Tizard's publication of 1900.[1]

In home waters, the *Triton* was in commission throughout the period, Tizard remaining in command until 1891. In 1889 she was joined by the *Research*, the last of the paddle-wheelers, of 500 tons, and specially built at Chatham for surveying, after the Hydrographer had shown that the charts of U.K. waters required more correction than the surveying service was previously able to perform. The *Knight Errant*, using a hired crew, continued in service until 1893, Archdeacon remaining in command until shortly before his death that year. She was succeeded by the hired vessel *Gladiator*, and from 1894 there was another party in a hired launch, the *Endeavour*, in 1902–3, which was regularly employed in the Admiralty harbours on the south coast of England—to become known as the south-coast-of-England survey.

Surveys on England's east coast by the *Triton* included the banks off the Norfolk, Lincolnshire, and Yorkshire coasts, and many harbours, such as Dover, Harwich, King's Lynn, the Humber, Hartlepool, and Montrose. Much time was spent in the Thames and the Medway, particularly in the Thames estuary channels. In 1888 the central shoal in the Duke of Edinburgh Channel (formerly the Bullock), which had been first observed in 1882 and named the Shingles, was much larger, with a least depth of twenty-two feet instead of thirty. The report commented: 'Although this to a large extent detracts from the width, the Duke of Edinburgh Channel still remains the widest and deepest of the buoyed entrances into the Thames'; and annual resurveys, often described in the annual reports, were carried out from 1892. This is still (1966) the state of affairs. Tidal streams in the Dover Strait and Pentland Firth were observed, and also currents in the North Sea. In 1903 the tides on the North Sea banks were measured with a newly invented pneumatic gauge, the results being successful and important, and verifying the observations of Hewett in 1840.

The *Research* was first employed in 1889–90 in the approaches to the English Channel—' so important for fast ships making a landfall by soundings in fog '. She rode out gales at anchor in deep water; and facilities were given in her to a scientist of the recently formed Plymouth Marine Biological Association. There followed a similar survey in the northern approaches to the Irish Sea; and a variety of tasks from Spithead to the Shetlands, including the Kyle of Loch Alsh and lochs on the west coast of Scotland. In 1896 to 1898, the Firths of Forth and Cromarty were surveyed, and in these years

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[1] Bibliography 3, 3.

Dr G. H. Fowler[1] was embarked by arrangement with the Royal Society and the Fishery Board for Scotland in order to take temperatures and samples of living forms at various depths in the Faeroe Channel and north of Sule Skerry—experiments that were repeated in 1900 south-west of Ushant. In the Dover Strait in 1896, streams and currents were observed at various depths with a meter adapted from that of Lieutenant Pillsbury, U.S.N.,[2] and though the meter was still imperfect in 1901, its use established that movements on both sides of the strait extended from the surface to the bottom.

In the *Knight Errant*, and her successor, the *Gladiator*, there were surveys of the Bristol Channel with its roads, of the Menai Strait, and of many harbours on the coasts of Wales, western Scotland and Ireland. The last included Berehaven in 1895–96 and Ballydivlin Bay in 1903 in order to meet the needs of the battle-fleets; and it was for this purpose that many of the surveys of the period were undertaken.

In 1887 a survey of the Goodwins showed extensive changes from that of 1865 and found the swashway in the sands from Trinity Bay; the annual report described the changes. In July 1887 buoys were laid and fixed at Spithead for the Naval Review, at which the *Triton* was also present with members of the Royal Society on board as guests of the Admiralty. It has to be recorded that the *Triton* ran aground on Southsea Beach when returning to harbour, and it must have been with chagrin that Wharton commented thus on the report of the court of inquiry, '. . . the navigating officer was confused by the many lights and that the commander does not seem to have exercised the close supervision which good judgment would have dictated especially under the circumstances'. There were similar arrangements ten years later, and again for the Coronation Review in 1902, but on the postponement of the latter owing to Edward VII's illness, the *Research* returned to her survey of Loch Roag.

The records show that there were various examinations of magnetic anomalies as well as the building-up of information on tides and currents. In 1895, Vereker was employed in H.M.S. *Seahorse* to make sketches and views of leading marks and so on round the coast of England from the Scilly Isles to Dover and thence to Lowestoft. Next season he covered from Land's End round the Bristol Channel to the Smalls, the south and east coasts of Ireland from Bantry Bay to Belfast, and the Isle of Man.

In foreign waters the number of surveying ships employed varied from five to six, including the *Sylvia*, *Myrmidon*, *Magpie*, *Flying Fish*, *Dart*, *Rambler*, *Egeria*, *Stork*, *Penguin*, *Waterwitch*, and *Goldfinch*. The *Penguin*, commissioned in 1890 for service on north-west Australian coasts, was appreciably the largest ship to be adapted for surveying. Her weight was 1 130 tons, indicated horsepower 1 110, and complement 137. In addition, the survey of Newfoundland continued throughout the period, with a diversion to the St Lawrence and its Traverses in 1885–88. The hired steamer *Gulnare* came to the end of her service as late as 1902, and there was only one change of officer-in-charge, Tooker for Maxwell in 1891. In 1889 an important rock, twenty miles off Cape St Mary was found with the aid of a fisherman, Patrick Lamb, although ' he was giving up exclusive knowledge and indeed other boats crowded to such a favourite haunt of cod '. His name was given to the rock but it was not stated whether a reward was paid, as was to be officially authorized in later official instructions.[1] In 1903, attention was given to the eastern approaches to Belle Isle Strait, ' so often encumbered by fog ', and the *Goldfinch* crossed the Atlantic from Sierra Leone, taking deep-sea soundings to Bermuda, in order to assist the *Ellinor*, successor to the *Gulnare*, with outer soundings on the Newfoundland banks.

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[1] Dr G. H. Fowler, C.B.E., F.R. HIST. S., was Assistant Professor of Zoology at University College, London. As described later, he served in the Hydrographic Department in the 1914–18 war and originated its subsequent activity in oceanography. He was the original editor of *Science of the Sea : An Elementary Handbook of Practical Oceanography*. He died in 1940, aged seventy-nine.

[2] Described in *Hydrographical Surveying*, third edition, 1909.

Under the orders of the Dominion Government of Canada since 1883, Boulton carried on to complete by 1892 the surveys of Georgian Bay, Lake Huron. In 1891 his senior assistant, Stewart, mentioned earlier, went by the newly completed Canadian Pacific Railway to resurvey Burrard Inlet and to execute a large-scale plan of Vancouver Harbour, the terminal port of the Canadian Pacific shipping line.

On the west coast of North America, work was recommenced in 1897 with the recommissioning of the *Egeria* by M. H. Smyth at Chatham for service in British Columbia. When crossing the Atlantic, some observations in the Equatorial-current were ' somewhat startling ', but the Pillsbury current-meter was still suspect. Passing through the Strait of Magellan, various surveys were made on the coast of South America, and lines of deep soundings were run. Meridian distances, latitudes, and magnetic observations were frequently obtained—observations with which all ships abroad were concerned throughout the Wharton period, the telegraph being used for meridian distances wherever it was available. From 1898, surveys were made in the *Egeria* of British Columbia waters, extending to Queen Charlotte Sound and Juan de Fuca Strait—surveys which were to be continued until 1910 when the ship was finally paid off, to be sold in 1911.

In the West Indies, surveys were progressed on the Little Bahama Bank, in British Guiana and St Lucia, but in 1889 the schooner *Sparrowhawk* was no longer seaworthy and was sold for £101. The party returned home and the days of surveying in sail were over. In 1886 assistance was given to the Royal Society's eclipse expedition at Grenada. The surveys were continued in the *Rambler* from 1895 to 1898.

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[1] This is not the earliest report of a fisherman's help. There is one from Captain Bonham Bax who on 1 February 1877 succeeded St John in command of the *Sylvia* but died of dysentery a few months later, and is only briefly mentioned by Dawson. He had had experience on the China Station when commanding the *Dwarf* in 1871–74. In May 1877 he reported to the Commander-in-Chief that in accordance with his instructions he had visited Keelung, Formosa, and fixed Audacious Rock using the same fisherman as originally employed by H.M.S. *Lapwing*.

In Australia, surveys of the north-west coast in the *Meda* with expenses shared with the State of Western Australia were broken off in 1886 owing ' to a wave of short-sighted economy in the House of Commons '. When the *Meda* paid off, Coghlan recommended that a steam pinnace transported in the local mail boat would be far more expeditious and economical than sailing and manual labour in boats. It was, however, agreed, as will be shown, that a surveying ship should be allocated as opportunity offered. The other schooner, the *Lark* under Pullen, was employed on a variety of surveys in New Zealand, Australia, the Solomons, and the Coral Sea until 1887 when she was found unseaworthy.

In 1885 the Queensland Government lent the gunboat *Paluma* in order that the long-postponed survey of their coast and the Barrier Reef inner passage might be begun. It was carried on until 1894, G. E. Richards being succeeded by Pirie in 1889. In February 1893 floods put the *Paluma* high and dry in Brisbane botanical gardens, but eleven days later another unprecedented rise of the river refloated her. In 1895 the *Dart* succeeded the *Paluma* for six years, a period in which coconuts were successfully planted on islets in order to assist navigation and any shipwrecked mariners; but in 1901 in consequence of Australian federation, the arrangements for shared costs ceased and the survey was broken off for several years.

The *Dart*, a steam screw yacht of 470 tons, was first commissioned in 1883 by Moore, primarily for general service under the Commander-in-Chief, but she achieved much surveying work. In 1885 Field was in command, operating in the islands already mentioned, and he proclaimed the Trobriand Islands a British protectorate. In 1891 Frederick, then in command, forwarded a petition from native chiefs in the New Hebrides to be under British protection. In 1902 the *Dart* was in the Solomons, but was found insufficiently seaworthy for this work; she returned to the Torres Strait, ending her useful life early in 1904. Besides Field, two other future Hydrographers commanded the *Dart*, i.e. Purey-Cust 1892–95 and J. F. Parry 1898–1900. Doubtless the attraction of the station and the work made it a sought-after appointment. There were various references to contacts with the natives in Australasian waters and to the beneficial effect of a ship being regularly present with no other motive than surveying; only in 1890 did a report from the *Penguin* on the north-west coast of Australia refer to the natives as being implacably hostile. In 1891 Wharton referred to the north and west coasts as being barren, dangerous, and hostile, with a trying climate, which meant that no ship should be employed there for more than two seasons. In 1899 he spoke of the lack of fresh provisions and asked for a supply of preserved vegetables for ships on the station—not that the canning process was a new one, it had been available for the Arctic expeditions of W. E. Parry.

Several of the seagoing ships in foreign waters during the period were also engaged in Australian waters and the routes thereto. The *Flying Fish* was on the China–Australia route in 1885–86, the *Myrmidon* from the Indian Ocean to Darwin in 1886, in the Bass Strait, the Coral Sea, and, finally, on the north-west coast where she was followed by the *Rambler* in 1889–90 and the *Penguin* in 1891 looking for a navigable route. The *Penguin* was there again in 1899–1900, the cruise including a survey of Esperance Bay. The *Egeria* was in the Pacific in 1888–90, and the *Penguin* the South Pacific including the Solomon Islands, recently transferred from German protection, in 1893–98. In the latter ship, a ' much needed ' survey of New Zealand's North Island was commenced in 1901–3, the New Zealand Government defraying a ' moiety ' of the expenses. The *Waterwitch* was in the Fiji group in 1895–96, and on the western coast of Australia in the following year.

The work of both the *Waterwitch* and the *Egeria* was largely concerned with ' the growing desire to connect the great British possessions of Canada and Australasia by a telegraph cable ', and in 1889 the *Egeria* had orders to hoist the British flag on such islands of the Union and Phoenix groups as were under no European protection. A report from the *Egeria* on her deep-sea work in 1888 led Wharton to write to Aldrich: ' It was an epoch in the history of ocean depths and as no deeper than 3 300 fathoms has yet been found, yours is at least 1 000 fathoms deeper.' There had been a loss of thermometers owing to a shark's mistaking them for prey and biting the wire in half—the present author did not make history as he thought when some fifty years later he attributed the loss of a current-meter to the same cause. The cable project again involved the *Egeria* in 1899 when she was diverted from British Columbia surveys to a sounding cruise from Vancouver to Fanning Island via Honolulu. The *Penguin* was also involved, and obtained the deepest known sounding in 1895 in the Pacific.[1]

In 1891 Wharton was strongly averse to participating in a joint survey of the estuary of the Borneo River, as he was concerned about the climate there, remembering the loss of life on the survey of the Anglo-German boundary in the Bight of Benin. Field had, however, the task of visiting and reporting on the Netherlands surveying organization. He said that their standards were below ours but remarked on their use of bamboos, which resulted in their introduction into the British service. He also said their personnel was well fed!

On the China Station, activity was mainly confined to the coast from Hong Kong to Shanghai and the mouth of the Yangtze. The *Rambler* was there from 1886 to 1899, assisted during one season by a Chinese war-sloop with Purey-Cust embarked, the *Penguin* in 1892, and the *Waterwitch* from 1898 onwards, being joined again by the *Rambler* in 1902. The *Egeria* was in Hong Kong, Borneo, and Malayan waters from 1891 to 1893, and surveyed Singapore's new harbour in 1891.

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[1] See p. 189.

In the Mediterranean and the Red Sea, the *Sylvia* arrived from Magellan Strait via Africa in 1885 and remained until 1888 with a diversion in 1886 to Bathurst. When in 1887 Turkish permission for surveys in the Gulf of Volos was temporarily withdrawn, the *Sylvia* was ordered to the Red Sea where in bad weather a search for the Avocet Rock was unsuccessful. The *Flying Fish* also missed the rock when on passage homeward, but the next year (1888) the *Stork*'s search was spectacularly successful, and her cable had to be slipped as she dragged towards it. The annual report commented:

> It is a matter for much astonishment that this dangerous rock, so near to the line of the very heavy traffic of the Red Sea, across which strong transverse currents often set, should not have been struck or sighted before; but the fact that four searches had to be made before it was found, shows how difficult it is to find such a patch, and the absence of a breaking sea upon it is a warning how, in a heavy short sea, without an ocean deep swell, such a danger may never reveal itself to the eye. It is also a subject for national congratulation that slightly manned cargo vessels first struck it, and not crowded mail steamers or troopships, or expensive ironclads, when the loss of life might have been appalling.

On the east coast of Africa, the *Stork* worked from 1888 to 1892 northward of Zanzibar; the mainland was then occupied by the Imperial British East Africa Company, a constant watch being kept for slavers by H.M. ships. The boundary with the German protectorate was surveyed, and in 1889 Mr H. H. Johnston was taken from Mozambique up the Zambezi to the river Shire, using a steam whaler and handing over to the African Lake Company's steamer at Morambala. In 1891 the *Stork* was transferred to the Mediterranean where she remained until she paid off in 1899 except for a diversion to Mauritius's Grand Port in 1897. A rock, Day Rock, named after a lieutenant on board, was found in Port Platea in 1892, and ' it might well have been struck by ships of the Mediterranean Fleet on exercises ', for which the surveying work in these waters was mainly undertaken. The *Goldfinch* succeeded the *Stork* in the Mediterranean in 1902 but the next year was sent to the Niger delta and from there, as earlier mentioned, crossed the Atlantic to the Newfoundland banks. The west coast of Africa, Sierra Leone, the river Forcados, and the river Congo were visited by the *Rambler* in 1899. On this coast ten years earlier the establishment of telegraphic communication had led to the completion of a chain of meridian distances which Pullen undertook on leaving the *Stork* at Simonstown in June 1889. His instructions included the survey of the Anglo-German boundary in the Bight of Benin, but not before the end of the November rains. He achieved much of the programme in disregard of the unhealthy climate, from which he had previously suffered and which brought his death from malarial fever at Bonny in November, ' it may almost be said with his instruments in his hand '. The South African coast from Cape St Lucia to Delagoa Bay had been surveyed by Aldrich after he had joined the *Sylvia* at the Cape in 1884, and floating beacons were successfully used in a spell of good weather on this ' disagreeable coast '.

The Marine Survey of India, under the orders of the Indian Government but in close touch with the Hydrographer, continued surveys of the coasts of India and Burma, the Bay of Bengal, and the Indian Ocean island groups. The ship was the paddle-wheel *Investigator*, Carpenter having succeeded Dawson in 1884. Much attention was given to scientific observations, both Carpenter and his assistant, Channer, having gained experience on the *Challenger*'s cruise. Hoskyn took over in 1889, and after his death at Bombay in 1892, Oldham commanded the survey for five years until succeeded by Heming. During the period, the five naval assistants of 1884 were gradually reduced and replaced by officers of the Indian Marine, prefixed Royal in 1892.

Scientific observations were much encouraged by Wharton, and mention has already been made of magnetic observations, deep-sea soundings, and ocean-current measurements. In 1884, H. B. Guppy, surgeon of the *Lark*, took every opportunity to collect flora and geological specimens at Treasury Island and elsewhere; and it was recorded that his voluntary exertions led to his being invalided from the service. His collections were sent to the British Museum, and in 1887 his book on the Solomon Islands and their natives was issued to ships on the Australia Station. The year 1886 saw the distribution of a textbook on geology and a box of specimens to surveying ships. A letter of 1887 from Wharton to Maclear after the latter's visit in the *Flying Fish* to Christmas Island in the Indian Ocean, said his report and collection had been received with joy by the British Museum; and, by arrangement with the Royal Society, J. J. Lister was embarked as naturalist in the *Egeria* for a second visit that year under Aldrich, who made another valuable report. At this time, in Wharton's words, a storm was raging over the question of coral formations, and geologists were a good deal excited at an astonishingly steep slope that had been reported by Maclear. In 1888 there was a useful report on coral-reefs in the South China Sea from Bassett-Smith, surgeon of the *Rambler*; and in 1896, by arrangement with the Royal Society, a party under Professor Sollas[1] was embarked in the *Penguin* to undertake borings at Funafuti Atoll, but despite prolonged efforts they were unsuccessful. In 1892, Bassett-Smith, now in the *Penguin*, and the chief engineer, Walker, had made an extensive natural history collection on the eastern China coast. In 1904, J. Gardiner's[2] request through the Royal Society for assistance with oceanographic investigations between southern India and Madagascar was sympathetically discussed, and arrangements were made for a cruise in a surveying ship during the following year. Also in 1904 the Hydrographer obtained the loan of H.M.S. *Seahorse* for kite-flying experiments on behalf of the Meteorological Society.

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[1] W. J. Sollas (1849–1936) was variously Professor of Zoology, Geology, and Palaeontology at the Universities of Bristol (1880), Dublin (1883), and Oxford (1887) where he remained until his death. He became a Fellow of the Royal Society in 1889 and was President of the Geological Society from 1908 to 1910.

[2] Professor J. S. Gardiner, F.R.S., took part in the expedition to Funafuti, and from 1897 organized and led expeditions to the Indian Ocean and the Pacific, including that in the *Sealark* (see p. 227). In 1909 he became Professor of Zoology at Cambridge. After the 1914–18 war, when Director of Fishery Investigations at the Ministry of Fisheries, he attended discussions on the development of oceanography in the Hydrographic Department (see p. 313). He died in 1946 aged seventy-four.

As has been shown, naval officers were encouraged by the institution of the Shadwell Testimonial to send in hydrographic surveys; and much useful information was received from cable companies and harbour authorities as well as by interchange with other hydrographic offices, to which a newcomer was the Philippines in 1901. Annual reports listed documents worthy of mention since 1882, such as 'Port Churchill' by Lieutenant A. R. Gordon in the Canadian Government ship *Alert* (1886), and 'The Yangtze' by the Chinese Imperial Maritime Customs. An interesting item of 1897 was a survey of Princess Alice Bank south of the Azores by His Royal Highness the Prince of Monaco, who, in 1919, was to help in the establishment of the International Hydrographic Bureau.

Surveying ships and parties were guided by *General Instructions for Hydrographic Surveyors*, which had new editions in 1884, 1888, and 1902, embodying intervening supplements; by *Instructions to Officers in charge of Admiralty Surveys*; and by Wharton's *Hydrographical Surveying* dated the *Sylvia*, 1882, which had a new edition, Field cooperating in 1898. There was also Shortland's *Nautical Surveying* published in 1890, two years after his death.

General Instructions for Hydrographic Surveyors was completely redesigned in the 1888 edition, using sections, numbered paragraphs, and an arrangement similar to that of the present day. Instructions were more specific and were 'to be adhered to closely by all Admiralty surveyors'. The preamble referred first to a complete survey and the importance of method, using standardized records, forms, and books. It mentioned scientific requirements, particularly those in the deep sea regarding oceanic circulation, without which no complete knowledge of the laws governing climate in general can be obtained; it concluded with geology and botany as studies to be advanced in the lesser-known quarters of the globe.

Section I on instruments and books laid down the individual allocation to assistants of sounding-sextants and station-pointers in daily use, the method of entitling books, and an establishment for the surveying library, including *Hints to Travellers*, Shortrede's logs, and Dawson's *Memoirs of Hydrography*. Section II required the chart to be in every sense complete, and noted: 'The charting of the globe has now so far advanced that, as a rule, a survey should be thorough. This expression mainly refers to the soundings, undoubtedly the most important part of a chart.' This established a change of priority, but much else in Wharton's edition supported previous conclusions, and Beaufort's dictum is recognizable in:

> The leading rule with regard to the scales of the charts and plans in every survey, should be that they distinctly show all those minutiae of the

> coast which may be required to be known, not only for the purposes of navigation, cruising and landing, but also for reference hereafter by courts martial or other authorities in cases of wreck &c. when the original drafts of the survey have become deposited documents in the Admiralty. The scales on which it may afterwards be expedient to publish them for the benefit of the seaman or the geographer depend on a variety of circumstances of which the surveyor can scarcely form an accurate judgment when carrying on the survey.

A duplicate tracing of the work was to be kept and this was to become known as 'the collector'. Daily projection of the day's work each evening was re-emphasized as 'an inflexible law'. The types of lettering were to follow those used in a modern published chart.

Detailed instructions in Section III on writing Sailing Directions ran: 'All fine writing and all roundabout phrases are to be avoided. The language should be simple, seamanlike, concise, and perspicuous; no ambiguous expression should be admitted.' The Admiralty system of orthography[1] was explained fully in Section IV, which stated that all geographical names in countries that used the roman characters should be spelt as by the respective nations, or as generally recognized by Englishmen. Both forms might be necessary, e.g. Livorno (Leghorn). Section V covered movements of the water, with an addition in 1902 that tidal streams should be referred to the time of high water at a standard port. Section VI discussed astronomical observations, meridian distances and variation ashore and afloat. A final section gave general instructions on making amendments to charts and Sailing Directions when on passage; it concluded with the needs of science for oceanographic data on both depths and temperature, 'all such information being gladly welcomed by scientific men, and it is to H.M. surveying ships that they look for it'. Appendices covered the supply of books, forms, and stationery from H.M.S.O., the abbreviations used on Admiralty charts, and tables of secondary meridians. By 1902 a warning was added that the galvanizing of sounding-wire protected it for a limited time only, unless due precautions were taken.

Instructions to Officers in charge of Admiralty Surveys was a confidential issue in booklet form in 1887, followed by revised editions in 1903, 1909 and 1914. It contained sections as follows: I. On correspondence, including letters of proceedings and semi-official letters to which the Hydrographer attached great value. II. On surveying assistants and particularly their advancement. (Although zeal and good conduct were elements there was also requisite knowledge and the qualifications needed for each grade were set out. Officers-in-charge were reminded of their responsibility to provide experience and instruction. Facilities for commissioned non-executive officers to act and be paid as fourth-class assistants were mentioned.) III. On the care of and accounting for instruments and special stores; and the extra issue of provisions and gratuitous clothing. IV. On the surveying contingent account; and rewards to fishermen and others with local knowledge, the amount of which must vary with circumstances. V. On general subjects, including the cautionary signals, as for laying a cable, that a surveying ship could show, although collision regulations had not been amended; and the arrangement whereby officers could receive copies of charts published from the results of their work.

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[1] See p. 129.

Only a copy of the 1914 edition has been found and it is now in the Hydrographic Department's historical records. It seems likely, however, that the edition of 1887 was more or less similar, and that Wharton was the first to lay down a set of qualifications needed for advancement in the grade as assistant surveyor.

A measure of Wharton's achievement is that his *Hydrographical Surveying* ran into four editions, and was not replaced by the Admiralty manual until 1938. The preface referred to young surveyors' having no book, now that Belcher's former standard work was out of print, and added that the lapse of time and the introduction of steam have placed many additional means at the disposal of the marine surveyor. An aspirant needed a quick eye, good common sense and a boundless capacity for taking pains. As it was a profession of volunteers, no other branch had juniors more anxious to do their duty, and there was the satisfaction to the surveyor that a permanent record of all he does will remain in the chart which is to guide hundreds of his fellow seamen on their way.

There were nineteen chapters covering: instruments; a survey in general; bases; triangulation; plotting; running survey; coastlining; sounding; tides; topography; heights; observations for latitude and longitude; meridian distances; true bearing ashore and afloat; the completed chart; deep-sea sounding; and miscellaneous subjects, such as paper distortion, undercurrents, exploring a river, and swinging ship. As regards sounding, it said that if any item is to be picked out, perhaps sounding should rank in the highest place; it is least pleasant in bad weather or over an uninteresting bottom, but the notion that it should be relegated to juniors is hard on them and may introduce errors. ' Steam cutters are of course the best boats for general sounding as the engine never tires ', but they should be fully rigged ' as accidents will happen as the boiler gets old.' In the ships, according to both the 1882 and 1898 editions, a steam winch hove the lead forward, but there were different methods of slipping it from the rounding-line. In one case, a board at the yard-arm was struck, and in the other there was a metal palm that acted on striking the water. In both cases the slip had to be reattached each time the lead was hove up to the sounding-davit aft.

The 1898 edition showed a beacon having two 27-gallon casks, which became known as the Egeria, and also the submarine sentry. The chapter on deep-sea sounding in 1882 was from Davis and Shortland of the *Hydra* and Buchanan of the *Challenger* expedition. The Lucas[1] machine received mention, but was more fully described in 1898 when Wharton acknowledged that there had been a revolution from the substitution of wire for hemp, and that he was greatly indebted to Field and Moore in supplementing his limited experience of wire. The sounding-rods mentioned were the Brooke, Hydra, and Baillie in 1882, and the Baillie and Driver in 1898.

In his preliminary remarks, Wharton introduced two precepts that the present author has remembered from his early days in surveying in 1920, to wit, ' Omissions there must always be but let there be no sins of commission ' and, paraphrased somewhat, ' No day is too long for the ardent surveyor ', which Belcher had put in a different way in 1835.[2]

Wharton also stressed that without zeal the attention and interest will soon fail. These dictums were seized upon in *The Bogus Surveyor, or, a short history of a peculiar people* by Whitewash, the surveyor's friend.[3] This book was a scurrilous skit, but is mentioned since, if the bitterness overlaying the humour can be overlooked, it illustrated the daily life of the surveyors of the time and showed how juniors, as of yore, learnt their profession from the captain and were advanced in grade largely on his recommendation. To quote: ' It sometimes happens that the Captain (like Moses) may go up a mountain for two or three days; should he desire your company, make yourself useful by carrying the necessary stores up the hillside.' By inference the author did not get on with his captain since he referred to ' the celebrated Captain Kellett and the kindly Sir Edward Parry '. The booklet was no doubt privately published and was undated. However, from the ships it listed the date was 1887 and the author is almost certainly identifiable as Charles Gleig,[4] who, to give him his due, later wrote in *The Navy and Army Illustrated* magazine of 1896 an appreciative article on ' How seas are surveyed and coasts charted '.

Gleig sailed for a commission in the *Rambler* under Vereker in 1885 for a formidable year's cruise which, relevant in this context, did not give any opportunity for the customary period of three months in harbour, traditionally ' to recruit the health of the crew ', and for drawing the charts of a season's work. Leaving England in January, the cruise carried out work at Malta, Trinkitat in the Red Sea, and Diego Garcia, before arriving at Singapore in May and Hong Kong in June, having run a continuous chain of meridian distances from Plymouth. Between July and September, the salient points on the coast from Hong Kong to Shanghai were fixed, and soon after arriving back at Hong Kong in the latter month, the *Rambler* was at sea again surveying Haitan Island and vicinity. This survey continued until November when Moore succeeded Vereker; a large-scale survey of Hong Kong Harbour was then started, which continued until the end of December.

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[1] F. R. Lucas as a youth was in the *Great Eastern* for the laying of the Atlantic cable. He was chief engineer of the Telegraph Construction & Maintenance Company when Admiral Richards was managing director, and he later filled the latter appointment. He introduced many new ideas into ocean cable-laying.

[2] See p. 65.

[3] Bibliography 3, 16.

[4] C. H. A. Gleig is shown in various editions of *The Navy List* in the *Rambler* as a sub-lieutenant and lieutenant from 1885 to 1887 and in the troopship *Tyne* in 1889, but thereafter his name disappears.

The hardships of surveying ships' companies, of concern to Gleig, were pointed out by Moore in 1890, to which Wharton replied that they were much worse in the earlier days, but in May 1891 he took the matter up with the Board. He thought that, as the glamour of exploration was over and no special credit was given to the toil, the time had come to grant extra pay to petty officers and men—' From what I hear and probably from the causes I have mentioned there is a feeling that they are hardly used as compared with their comrades and much as I regret the fact and the necessity for doing something I have had forced upon me that the necessity exists.' He proposed an allowance of 1*d* per day for all crews abroad and 2*d* in the tropics; 4*d* for a trained surveying man, 1*d* for leadsman and 2*d* for boat coxswains, these men being volunteers. The views of the First Sea Lord, Admiral Hoskins, were: ' The surveying service used to be very popular indeed and that it is not so now is probably partly though not entirely due to some recent disciplinary occurrence. [A reference presumably to the *Egeria*, Oldham, in the Pacific.] (a) The crews should be changed frequently, never exceeding three years in commission, and I do not anticipate any difficulties if the officers in command are well chosen. Everyone both inside and outside the service, appears to be using every possible lever to get increases of pay and decreases of work and the result is a general lowering of tone—to yield to the pressure when it is not a matter of doing justice would lower the tone far more.' The First Lord, Lord George Hamilton, minuted: ' I entirely agree in the above. (a) should be carefully attended to. 18.4.92.'

Frequent occurrences of ill health and casualties were recorded in the annual reports. The ships had long lives, and in 1897 Wharton reported that the six ships abroad were very old, especially the *Stork*. He said that conversions were uneconomical and unsatisfactory, and described the requirement as a ship of 1 000 tons with a draught of not more than fifteen feet, of composite construction, and having a single screw plus sail power for passages. But the Board ruled thus: ' For the present some existing ship must be prepared and utilized for this service.' This ship was the *Goldfinch* in 1902. Previously, in 1887, Wharton had argued against the use of hired vessels, and of crews not under the Naval Discipline Act. He thought the Board would recognize the great value of the factor, ' pride in his ship ', which was (and is) such a strong element of the efficiency of every branch of the naval service and especially of the executives who furnished the majority of surveyors. Incidentally, two months earlier he had agreed with the commanding officer of the *Egeria* that ' it would be absolutely impossible to keep a surveying ship painted white in any way respectable with the establishment of paint and time at her disposal '.

The administration of the ships continued to be the Commander-in-Chief's responsibility, and on this matter Wharton, writing in 1890 to Pirie in the *Paluma*, said: 'The relation between Commanders-in-Chief and surveying ships is always a somewhat delicate one and requires tact, more or less according to the character of the Admiral, but as regards your movements they have nothing to do with them unless they choose to interfere, when of course you obey.' In 1887, after much sickness in her ship's company, the *Sylvia* was not allowed to proceed to the Red Sea before a special inspection by the Commander-in-Chief, Mediterranean. In 1899 the *Rambler* on the Angola coast had a forty-per-cent incidence of fever in a fortnight, and was sent to Ascension Island to recuperate her crew, but in 1903, also on the west coast of Africa, Learmonth in the *Goldfinch* was successful in his measures to avoid fever. As already recorded, there was a mention of preserved vegetables in 1899 for ships on the Australia Station, where there had been many cases of sickness, and where fresh vegetables were unobtainable.

The number of surveying officers employed afloat, as well as the total numbers of officers and men was given in the annual reports. The former ranged between forty and fifty, the latter reaching eighty and seven hundred; and there were references in the difficult years of 1891–93 to ships abroad being unavoidably short of surveying officers.

The Hydrographer made half-yearly recommendations for the promotion of staff and executive officers to commander and captain from 1887 onwards in accordance with a memorandum by the Secretary. In that year Wharton argued that to secure the services of a sufficient number of officers of high qualifications, the chances of promotion should be equal to that in other branches; and he quoted figures. He had to use the same argument in 1894; and in 1899, when he proposed Learmonth's promotion to commander, he said there were five others more senior, but he ' hoped that, if approved, it would encourage volunteers, the falling-off in their number being entirely due to the absence of prospects of early promotion '.

Like his predecessors Wharton took the opportunity of pointing out the good work for Their Lordships' approbation. Field was mentioned in 1893 and 1897, Gedge in 1897, and Pasco in 1903; and there were others.

Biographies: Afloat and ashore

STAFF CAPTAIN W. E. ARCHDEACON, R.N.

1857–1893

William Edwin Archdeacon entered the Navy in 1854, serving in H.M.S. *Dauntless* in the Baltic and the Black Sea during the Crimean war, 1854–56. He joined the surveying service in 1857 and served in the *Columbia*, Shortland, in the Bay of Fundy for nine years, being made a navigating lieutenant in 1865. In 1866 he joined the Cape-of-Good-Hope survey under Stanton, from whom he took over the charge at the end of 1867. This survey was concluded in 1872 when Archdeacon and his party were transferred to Western Australia to begin the survey of its coasts. In February 1880, the schooner *Meda*, built and equipped conjointly by the Imperial and colonial Governments, was ready, and Archdeacon, assisted by Tooker, sailed her out to arrive at the Swan River some six months later.

Archdeacon, promoted to staff commander in 1875, returned home in 1882 and assumed command of the west-coast-of-England survey, using the hired vessel *Knight Errant*. He surveyed in the Bristol Channel, Carmarthen and Cardigan Bays; in Ireland, Cork, Lough Foyle, and Dublin Bay; and in Scotland, the Firth of Clyde, Lamlash Harbour, and Campbeltown Loch. In 1887 his surveys included the Goodwin Sands and Heligoland. He was promoted to staff captain in 1892, but his death came early the next year, upon which Wharton commented that it had been brought about by his devotion to duty in insisting while very ill on superintending surveying operations. Archdeacon was a man of great energy and industry and he had a remarkable record of thirty-six years of continuous surveying afloat.

CAPTAIN L. S. DAWSON, R.N.

1875–1891

Llewellyn Styles Dawson served as a midshipman in the surveying ships *Medina*, Spratt, and *Hydra*, Mansell, from 1863 to 1865 in the Mediterranean. For the next five years he was on the coasts of China and Japan in the *Serpent*, Bullock, and the *Sylvia*, Brooker and St John. He was specially promoted to lieutenant in 1869 for his very useful survey of the upper waters of the Yangtze, ' of special advantage to the mercantile community in China '. Trouble with his eyesight brought him home in 1870 for treatment, and the following year he was surveying in the river Plate, working from H.M. ships on the station.

After a short attachment to the department, Dawson volunteered in 1872 for the command of the Livingstone search expedition, and was granted eighteen months' leave by the Admiralty. However, in August, after six months, he resigned the command and returned to England. Next, in 1873, Dawson was sent by Richards to join Moresby, who had been exploring the coasts of New Guinea since 1871, from which service Dawson went in 1875 to command first the *Renard* and then the *Alacrity*, surveying in the Fiji Islands. In March 1876 he was invalided home and joined the department in September that year as a naval assistant. Five years later he was selected by the Hydrographer to be the first Royal Naval surveying officer to be in charge of the reorganized Marine Survey of India, his special promotion to commander in 1881 having been on the presentation by the Hydrographer of his first report to Parliament on the activities of the surveying service. He was relieved from this appointment towards the end of 1884 by the Indian authorities on account of an abnormal mental condition. Dawson subsequently challenged his removal; and by October 1885 the Hydrographer was able to propose his appointment in command of the *Sylvia*, in which he surveyed the north-west coasts of Africa and Spain, and the Turkish and Greek coasts in the Mediterranean and in the Rea Sea before paying her off at Sheerness at the beginning of 1889. In May of that year he took over command of the *Rambler* at Thursday Island, and worked in Torres Strait approaches before transferring to the China Station and the Chusan Archipelago. He brought the ship home to pay off in July 1891.

This was his last naval appointment, but in 1895 he was lent for two years to the Government of Western Australia for surveys of their coasts. He retired as a captain in 1897 and died on 8 December 1921 aged about seventy. During his long and active career, Dawson found time to write the extensive *Memoirs of Hydrography*, of which Part II was published in 1885, and which were presumably begun during his appointment to the department from 1876 to 1881.

COMMANDER T. F. PULLEN, R.N.

1875–1889

Thomas Francis Pullen joined the *Shearwater*, Wharton, as a sub-lieutenant in 1872, the surveys being in the Mediterranean, the Red Sea, and on the east coast of Africa. He was promoted to lieutenant in 1875 and appointed in charge of the West Indies survey, for which he commissioned the *Sparrowhawk* a year later. From 1881 to 1883 he was in the *Fawn*, Aldrich, mainly in the Red Sea, followed by his appointment as senior commissioner of the boundary commission on the Gold Coast, receiving ' the satisfaction of Their Lordships ' for the manner in which he executed this task.

In 1884 he took command of the *Lark* on the Australia Station for two seasons, being principally engaged on surveys of the coasts of New Guinea.

The *Lark* was condemned as unseaworthy in 1887, but Pullen remained in Australia for another six months and completed a survey of Sydney Harbour.

In 1888 Pullen commissioned the *Stork* at Chatham, and while on passage to the east coast of Africa he had the satisfaction of finding Avocet Rock in the Red Sea after several unsuccessful searches had been made. The Hydrographer, writing to him in May, said: '[It] has caused the greatest excitement and it is indeed a subject of congratulation both to the officers of the *Stork* and to this department.' He was succeeded by Balfour at the Cape in June and was then employed on observing telegraphic meridian distances on the west coast of Africa, made practicable by newly laid submarine cables. This work was to be followed by a survey, in connexion with the Anglo-German boundary question, of the rivers debouching into the Rio-del-Rey, but the Commander-in-Chief's orders said that it was not to be commenced until late November in order to avoid the rainy season. Pullen, however, took an earlier opportunity to visit Bonny for an astronomical fix; he there contracted malaria, which caused his death in 1889, 'it may almost be said with his instruments in his hand'.

Captain J. E. COGHLAN, R.N.

1876–1893

James Edmund Coghlan was in the *Rifleman* on the China Station from 1862 to 1867 under the successive commands of Reed and Ward. He was promoted to second master in 1866 and made a navigating lieutenant the following year after passing a meritorious examination. In 1868 he joined the Vancouver Island survey under Pender, and three years later went to the Cape-of-Good-Hope survey under Archdeacon, with whom he transferred to the west coast of Australia in 1872.

At the end of 1874 Coghlan was appointed deputy to Taylor, Superintendent of Indian Marine Surveys, but remained for only a year before being given charge of the survey of Mauritius, which, conducted in boats, occupied him for two years. Back in England in 1878, Coghlan joined the *Porcupine*, Parsons, on east-coast-of-England surveys. He was promoted to staff commander in 1879 and transferred two years later to the Newfoundland survey under Maxwell. From 1882 he was in charge of the surveys in the *Meda* on the west coast of Australia. When the survey was broken off at the end of 1886, he recommended that a steam pinnace transported in the local mail boat would be far more expeditious and economical than sailing and manual labour.

In 1887 Coghlan carried out surveys of Sligo Harbour and Loch Long before joining the *Triton*, Tizard and later Maxwell, in which he surveyed for six years on the east coast of England. He retired with the rank of captain in 1897.

REAR-ADMIRAL W. U. MOORE

1876–1900

William Usborne Moore served as a midshipman in the *Hydra*, Mansell and Shortland, from 1865 to 1868 in the Mediterranean. He was promoted to sub-lieutenant in 1868 and the following year joined the *Newport*, Nares, working in the Red Sea and the Mediterranean. He continued there and on the east coast of Africa until he was transferred in 1871 to the *Shearwater*, under the successive commands of Nares and Wharton. He remained in the *Shearwater* for five years, having been promoted in 1872 to lieutenant.

From 1876 to 1881 Moore commanded the *Alacrity*, principally surveying in the Fiji Islands. In 1882 he transferred to the *Dart* under the orders of the Commander-in-Chief, Australia, but was able to execute surveys in the New Hebrides and other Pacific islands for three years.

In 1884 Moore was made a commander, and at the end of 1885 succeeded Vereker in the *Rambler* on the China Station. In 1886 he completed a remarkably fine piece of work begun by his predecessor in the fixing of the salient points on the China coast from Macao to Shanghai; he also surveyed in the Chusan Archipelago and on the coast of Borneo. In February 1889 he handed the command back to Vereker and a year later commissioned the *Penguin*, sailing via Suez for surveys on the north-west coast of Australia. For two years he worked on this unpleasant and monotonous survey in intricate waters where the natives were implacably hostile; and at the end of 1890 he wrote about the hardships of the surveying service to the Hydrographer, who a few months later made an unsuccessful attempt to obtain extra pay for ships' companies. Moore was made a captain in 1892, and before leaving the *Rambler* in 1893 he returned to surveys of the China coast.

A long period of service in foreign waters was followed by Moore's appointment in 1895 to the *Research*, in which he spent much time in Scottish waters during the five years of his last surveying appointment.

He retired in 1904 and was subsequently advanced to rear-admiral on the Retired List.

ADMIRAL P. ALDRICH, C.V.O.

1877–1891

Pelham Aldrich was with Nares in both the *Challenger* expedition of 1872–76 and the Arctic expedition of 1875–76. In 1877, when a commander, he succeeded Bax in command of the *Sylvia* in Japanese waters, and in 1881 he went to the *Fawn*, surveying in the Red Sea and on the east coast of Africa. He was promoted to captain in 1883, and in the following year returned to the *Sylvia*, joining her at the Cape and executing a survey of South African coasts before transferring to the Mediterranean for a year's work. At the end of

1866, Aldrich commissioned the *Egeria*, relief for the *Flying Fish*, doing some examinations in the Red Sea *en route* to Ceylon. In September 1877, with the naturalist Lister embarked, he visited Christmas Island and furnished a full account of great interest. In 1877, deep-sea cruises were undertaken in the western Pacific for the projected telegraph cable between Canada and Australia. Wire sounding was in its infancy, and the Hydrographer, Wharton, spoke in 1888 of Aldrich's capital report and an epoch in history in attaining depths of 4 000 fathoms.

In 1889 Aldrich was the first captain of the *Research*, which did useful work in the exposed south-western approaches to the English Channel among other home surveys, and he left her in 1891 at his own request. He subsequently commanded H.M.S. *Hawke*, and before his promotion to rear-admiral in 1898 was Inspecting Captain of Boys' Training Ships. In 1899 he was Admiral Superintendent, Portsmouth, and while in this appointment was responsible, at Wharton's instigation, for expeditiously fitting out the *Terra Nova* in 1903 as a relief ship for the *Discovery* beset in the Antarctic ice. He was awarded the C.V.O., promoted to vice-admiral in 1903 and admiral in 1907, retiring in the following year.

CAPTAIN G. E. RICHARDS, R.N.

1877–1902

George Edward Richards served as a sub-lieutenant in the *Sylvia*, St John, from 1873–76 in Japanese waters. In 1876 he was appointed to the *Wolverine* under the orders of the Commodore Commanding in Australia for such surveys as he might require, and was promoted to lieutenant. He remained in these waters for seven years, commanding either one of the two schooners *Alacrity* and *Renard* from 1877, and visiting the Solomon Islands. In 1881 he was given charge of the Fiji Islands surveys, again using one or other of the two schooners.

Richards spent 1883 at home in the department, and the next year returned to Australian waters where he surveyed for four years and a half the inner route off the coast of Queensland in the *Paluma*, a gunboat lent by the State, which rode so ' low in the water . . . that in rough seas her decks were constantly flooded '. Back home in 1889 he became a naval assistant in the department for four years, being promoted to commander in 1891. He then commanded the *Triton* for a season on the east coast of England, and in 1894 commissioned the *Rambler* for service on the North America Station. After surveying the Sherbro River, Sierra Leone, he was employed for three years in the West Indies and the approaches to Halifax.

Richards was made a captain and returned to England at the end of 1897. He again commanded the *Triton* from 1899 until 1902, in which year he was placed on the Retired List.

VICE-ADMIRAL J. F. L. P. MACLEAR

1879–1887

John Fiot Lee Pearse Maclear, who was promoted to commander in 1868, served in the *Challenger* expedition, Nares succeeded by Captain F. T. Thomson, from 1872–76. On its conclusion, he was responsible for preparing the magnetic observations for publication, and was made a captain. His service previous to 1872 had included a great amount of active operations, including the Kaffir war of 1851, the Crimean war of 1854–56, the Chinese war of 1860–63, and the Abyssinian campaign of 1868.

In 1879 Maclear was appointed in command of the *Alert*, and for three years and a half surveyed in the Magellan Strait and then in the Indian Ocean or Australian waters. In 1884 he succeeded Hoskyn in the *Flying Fish*, and first completed the surveys of Korea, preparing a valuable and detailed report on that country. He was then on the China–Australia route, and on the way home in 1887 his was one of the ships to visit Christmas Island, from which he sent a report and a collection that were, according to Wharton, received with joy by the British Museum.

Maclear was promoted to rear-admiral and retired in 1891; he was advanced to vice-admiral on the Retired List in 1897.

CAPTAIN T. H. TIZARD, C.B., F.R.S., R.N.

1880–1891

Thomas Henry Tizard entered the Navy as a master's assistant in 1854 and served in the Baltic during the Crimean war. In 1860 he was promoted to second master and commenced surveying in the *Rifleman*, Reed, during which time he commanded the tender *Saracen* for three years on the China Station. Made a master in 1864, he was invalided home in 1867.

From 1868 to 1872 he was in the *Newport*, Nares, surveying in the Mediterranean and the Red Sea.

From 1872 to 1876 Tizard was navigating officer and chief assistant surveyor to Nares, and later F. T. Thomson, on the *Challenger* expedition, becoming a staff commander in 1874. For the next three years he was employed at the Admiralty compiling the narrative and the oceanographic and hydrographic results of the expedition, on which he was complimented highly by Sir Wyville Thomson, the senior scientist. The Hydrographer also recommended his services highly, but it was not until 1889 that Tizard was made a staff captain and a C.B. Meanwhile, he resumed surveying in 1879 in the *Porcupine*, Parsons, surveying in home waters, which surveys he continued in command of the *Knight Errant* from 1880. In 1882 he commissioned the new ship

Triton and stayed in her for no less than nine years, working on the east-coast-of-England surveys.

In 1889 Tizard was promoted to staff captain, and in 1891 became Assistant Hydrographer, a post which he held until 1907, although placed on the Retired List with the rank of captain in 1896. His evidence to the committee of inquiry into the Hydrographic Department in 1905 was extensive and informative, and it was reproduced in the committee's report. While he was Assistant Hydrographer, he served on the Joint Committee of the Royal Society and Royal Geographical Society for the National Antarctic Expedition of 1901–4, and in 1902 he was sent to Gibraltar to report on the feasibility of a harbour on the eastern side of the Rock. In 1904 he received a fee of fifty guineas for services rendered to the promoters of the Humber Commercial Railway and Dock Bill.

Tizard was elected a Fellow of the Royal Society in 1891, and served on its council from 1902–4. He was one of the most distinguished surveyors of his day, and besides writing a number of scientific papers he originated the table of chords of arcs when a navigating lieutenant. After his retirement he worked as a reviser of departmental publications. He died at Kingston-upon-Thames in 1924 at the age of eighty-five.

Captain A. CARPENTER, D.S.O., R.N.

1880–1889

Alfred Carpenter served as a lieutenant for two years in the latter part of the *Challenger* expedition, although not as a surveyor. He joined the *Nassau*, Napier, on the China Station in 1877, and in 1880 he commanded the *Sparrowhawk*, surveying in the West Indies. From 1881 to 1883 he was in command of the *Magpie*, and undertook surveys on the coasts of China, Japan, Korea, and Borneo, being promoted to commander in 1883.

In February 1884 he commissioned the *Myrmidon* for surveying operations in the Red Sea, and while working at Suakin, his ship's company gave assistance in manning the lines against the Mahdi. In September of that year Carpenter succeeded Dawson in charge of the Marine Survey of India, and under the new arrangement worked more closely with the Hydrographer. In 1885–86 he cooperated with the Burma Expeditionary Force and led the flotilla up the Irrawaddy to Mandalay, a distance of 325 miles, making a sketch survey of the river over the whole distance. For this service he received the thanks of the General Officer Commanding and was awarded the D.S.O. Wharton's congratulatory letter to him has already been quoted (pp. 117–18).

Carpenter withdrew from the surveying service in 1890 and was retired with the rank of captain in 1895. In 1900 he became a director of the Submarine Sentry Company.

COMMANDER R. F. HOSKYN, R.N.

1880–1892

Richard Fraser Hoskyn joined the *Sylvia* as a lieutenant in 1870 and remained for ten years, surveying mainly on the coasts of Japan under St John until 1876, then Bax, who after six months died in Japan, and finally Aldrich. In 1880 he returned to England and as a lieutenant and commander commissioned the *Flying Fish* and sailed for the China Station to replace the *Sylvia.* Surveys were commenced in Korea in 1882, those of Japanese waters being concluded. The latter had been commenced twenty years earlier; and it was appropriate that Hoskyn now rescued six Japanese from attack in their Korean legation and received presents from the Mikado, including a handsome, inscribed, bronze vase. Wharton recommended their acceptance in view of the difficulty of returning presents to the Mikado.

Leaving the *Flying Fish* in 1883, Hoskyn, now a commander, took command of the *Myrmidon* the following year. After some surveys in the Red Sea, Hoskyn spent the next three years surveying in Australian waters, partly in the Bass Strait and the Coral Sea. In 1889 he succeeded Carpenter in charge of the Marine Survey of India and died at Poona in 1892 while holding the appointment.

COMMANDER W. S. WHITE, R.N.

1881–1885

William Shearburn White began surveying as a midshipman and was in the *Nassau*, Chimmo, on the China Station from 1870 to 1872 when he was promoted to sub-lieutenant. He remained in the *Nassau*, Gray and Napier, on surveys of the east coast of Africa until 1877, being promoted to lieutenant in 1873. In 1878 he joined the *Fawn*, Wharton, working in the Sea of Marmara.

Three years later, in 1881, White was in command of West Indies surveys in the schooner *Sparrowhawk*, where he remained until 1885. He was then appointed a naval assistant to the Hydrographer and served at the Admiralty until shortly after his promotion to commander in 1887. In 1891 he accepted an appointment in the coastguard service.

CAPTAIN C. F. OLDHAM, R.N.

1881–1897

Cecil Frederick Oldham served in 1871 as a midshipman in the *Shearwater*, Nares, on Mediterranean surveys. He was promoted to sub-lieutenant in 1872 and lieutenant a year later, having received accelerated advancement for gaining the highest marks in the examination at the Royal Naval College.

He then spent seven years surveying on the Japanese coasts in the *Sylvia*, successively commanded by St John, Bax, and Aldrich.

From 1881 to 1885, Oldham commanded the *Lark* on the Australia Station, principally in the Solomon Islands. In 1885–86 he conducted surveys in the West Indies in the *Sparrowhawk*, being promoted to commander in this appointment.

At the end of 1888, Oldham succeeded Aldrich in command of the *Egeria*, and continued the deep-sea sounding cruises in the Pacific on the Canada–Australia telegraph-cable route. He hoisted the British flag on islands in the Union and Phoenix groups; Lister, as naturalist, was embarked. Some indiscipline in the ship led to his supersession by Field in 1890, and in 1892 on the death of Hoskyn he went in charge of the Marine Survey of India.

On the termination of his service in India in 1897, Oldham joined the department as a naval assistant and remained at the Admiralty until ill health brought about his resignation in September 1904, having been placed on the Retired List with the rank of captain in April 1901. In the 1914–18 war he rejoined and was a duty officer in the department. He died at Canterbury in 1937.

Captain the Hon. F. C. P. VEREKER, R.N.

1883–1897

Foley Charles Prendergast Vereker began surveying in 1868 as a midshipman in the *Nassau*, in which ship he served for nine years, being promoted sub-lieutenant in 1870 and lieutenant in 1873. Initially, he was in the Magellan Strait under Mayne, then on the China Station from 1870 to 1873 under Chimmo, and finally on the east coast of Africa or again the China Station from 1873 to 1877 under Gray and Napier successively.

In 1878, Vereker was in the *Alert*, Nares, on South American coasts, and in 1879 he was appointed to the royal yacht *Victoria and Albert*. He was promoted to commander in 1881 and returned to surveying in 1883 in command of the *Magpie* on the China Station. In 1884 he commissioned the *Rambler* in England as a replacement for *Magpie*, and in 1885 carried out some surveys in the Red Sea on passage to the East, where, as has been mentioned (pp. 148–9), a formidable year's work was completed, at the end of which he was succeeded by Moore.

From 1887 until early 1889 Vereker was in the *Myrmidon* on Western Australian surveys and then transferred to the *Rambler* again on the coasts of China and Borneo, until his health broke down. He was promoted to captain at the end of 1888.

He next commanded the *Research* in home waters from 1891 to 1895 and, among other surveys, completed a general re-sounding of the approaches to Portsmouth. After leaving the *Research*, Vereker was specially employed for two seasons in making sketches of the English and Irish coasts from H.M.S.

Seahorse. He was an accomplished artist, and the reproduction of the *Nassau* (Figure 8) is from one of his water-colours.

In July 1897 Vereker succeeded Nares as Professional Adviser to the Harbour Department at the Board of Trade, an appointment which he held until his death in 1900.

CAPTAIN J. G. BOULTON, R.N.

1883–1893

John George Boulton served for three years from 1857 in the *Porcupine*, Otter, on west coast of Scotland surveys; and during this period accompanied Otter to Newfoundland in connexion with the landing there of the first Atlantic telegraph cable. In 1860 he joined the survey of Victoria, Australia, working for six years under Cox, which included one year of detachment for surveying in New Zealand waters during the Maori wars. He was made a second master in 1863.

In 1866 Boulton was on the survey of New South Wales under Sidney, and a year later was at the Cape of Good Hope where he surveyed under Archdeacon until invalided home in 1871. In 1872 he joined the Newfoundland survey under Maxwell, remaining for nine years and being made a staff commander in 1879. Back in England in 1881, Boulton was on surveys of the west coast in the *Knight Errant*, Archdeacon, for two years and then accepted an appointment under the Dominion Government of Canada to survey the Great Lakes, particularly the shores of Georgian Bay, Lake Huron. He completed this work in 1892 and was highly commended by the Canadian House of Commons.

In 1893 Boulton was appointed a naval assistant to the Hydrographer, and was made a staff captain in 1896. In 1898, when he left the Admiralty, he was placed on the Retired List with the rank of captain.

COMMANDER A. HAVERGAL, R.N.

1886–1889

Arthur Havergal joined the *Newport*, Nares, as a navigating midshipman in 1868 and surveyed for three years in the Mediterranean and the Red Sea. In 1871 as a sub-lieutenant he went with Nares to the *Shearwater* in the Red Sea and a year later accompanied him on the *Challenger* expedition of 1872–76. On his return to England he surveyed on the east coast for a few months in the *Porcupine*, Parsons, and was promoted to lieutenant.

In 1877, Havergal joined the *Sylvia*, Bax for a few months and then Aldrich, and spent four years surveying on the coasts of Japan. After a break of a year, he was again appointed to the *Sylvia*, Wharton, working in the Magellan

Strait. He stayed in the *Sylvia* under Aldrich from 1884, surveying on the coast of South Africa and in the Mediterranean. In 1886 he spent six months in the department before taking command of the *Sparrowhawk* in the West Indies. This schooner was found to be unseaworthy in 1899 and the party returned home. The last of the sailing-ships to be employed on surveying, she was sold for £101.

In July 1899 Havergal joined the department as a naval assistant in charge of Notices to Mariners, and continued there until 1908, being retired with the rank of commander in 1895. He rejoined for the 1914–18 war and acted as a duty officer in the department.

Captain A. F. BALFOUR, R.N.

1889–1896

Andrew Francis Balfour served for two years in the *Challenger* expedition of 1872–76, although he was not employed as a surveyor. In 1877, as a lieutenant, he joined the *Nassau*, Napier, on the China Station, and from 1878 for another six years on the same station he was in the *Magpie*, successively commanded by Napier, Carpenter, and Vereker. He came home in the *Magpie* in 1884, and at the end of the year joined the *Rambler*, Vereker, for further service on the China Station until 1889.

In 1889 Balfour took command of the *Stork*, surveying on the east coast of Africa and the Seychelles. He explored the Zambezi for 150 miles from the sea, taking the British consul at Mozambique, H. H. Johnston, up to the river Shire, whence, at Morambala, the latter continued his journey to Nyasaland in the African Lake Company's steamer. For this service, Balfour was commended by Their Lordships; and in 1890 he was promoted commander, paying off the *Stork* in that year at Malta.

From 1893 to 1896, Balfour commanded the *Penguin*, principally surveying in the Solomon Islands. He took many deep-sea soundings on passage between New Zealand, Fiji and the Solomon Islands, and had the satisfaction of obtaining soundings of over 5 000 fathoms to the eastward of a line joining the Friendly and Kermadec Islands. These soundings were 500 fathoms deeper than the deepest then known—a sounding north-east of Japan taken by the U.S.S. *Tuscarora* in 1875. Bottom-specimens were obtained.

Balfour retired with the rank of captain in 1898.

Captain G. PIRIE, R.N.

1889–1898

George Pirie was appointed in 1874 as a navigating sub-lieutenant to the *Porcupine*, Parsons, engaged in surveying on the east coast of England, but in the summers of 1875 and 1876 he had Admiralty permission to accompany

Allen Young on the yacht *Pandora*'s voyages to the Arctic. He was promoted to lieutenant in 1876, and early in 1877, went to the China Station, serving first in the *Nassau* and then the *Magpie* under the command of Napier.

Pirie returned home at the end of 1879 and joined the *Flying Fish* when she was commissioned in the spring of 1880 by Hoskyn for surveys off China and Japan. Three years later he was back in England, but left again for the China Station in January 1885 in the *Rambler*, Vereker and later Moore; he remained in the *Rambler* for three years.

From 1889 to 1893 Pirie commanded the *Paluma*, a gunboat lent by the Queensland Government in Australia for the survey of their coasts and the inner passage; he was made a commander in 1892. It was in February 1893 that the *Paluma*, when refitting at Brisbane, was put high and dry in the botanical gardens by floods, and escaped destruction only by the skill and energy of her crew, who were able to refloat her ten days later when there was another unprecedented rise of the river. In 1893 Pirie spent a short period in the department as a naval assistant, but he was at sea again in 1894 commanding the *Triton* on the east coast of England. He made annual surveys of the Duke of Edinburgh Channel, and one of the Goodwins in 1896.

Pirie left the *Triton* on his retirement with the rank of captain in 1898; he later became Conservator of the river Humber.

CAPTAIN G. C. FREDERICK, C.B.E., R.N.

1889–1892

George Charles Frederick joined the *Fawn*, Wharton, as a sub-lieutenant in 1876, and for four years was on surveys of the east coast of Africa, becoming a lieutenant in 1878. From 1881 to 1884 he was in the *Magpie*, Carpenter and Vereker, on the China Station, followed by a year as a naval assistant in the department. From 1885 to 1888 he was in the *Sylvia*, Dawson, surveying on the west coast of Africa, in the Mediterranean and the Red Sea.

In 1889 Frederick took command of the *Dart* on the Australia Station, and was mainly engaged in surveys of the New Hebrides for two years and a half. Here he found that the formerly barbarous natives had become friendlier owing to the presence of Presbyterian missions; and he forwarded a petition from the chiefs that they should come under British rule. He returned home in 1892, and served for five years as a naval assistant in the department, being promoted to commander in 1893. In 1897, on Underhill's resignation, Frederick became Chief Civil Assistant to the Hydrographer, a suggestion that the title should be Chief Naval Assistant not being pursued.

In 1901 Frederick retired and left the department to become the Professional Member of the Fisheries and Harbour Department at the Board of Trade until 1910. In 1914 he was the British representative on the International Commission on the port of Tangier. He was promoted to captain on the

Retired List in 1908 and awarded the C.B.E. in 1918, having been on the Admiralty War Staff at Liverpool from 1914 and subsequently Shipping Intelligence Officer at that port until May 1919.

CAPTAIN W. V. HOWARD, D.S.O., R.N.

1895–1897

William Vansittart Howard served as a lieutenant in the *Flying Fish*, Maclear, from 1883 to 1887, surveying on the China and Australia Stations. For the next three years he was in the *Stork*, Pullen and Balfour successively, on the east coast of Africa and in the Seychelles. In 1891 he joined the *Egeria*, Field, mainly on the coast of Borneo, but was invalided home in 1893. He then served in the *Research*, Vereker and later Moore, in home waters.

In 1895 Howard took command of the *Dart* in Australia and worked mainly on the coast of Queensland but also in Tasmania, until in 1897, just before his promotion to commander, he was again invalided home. In 1898 he became a naval assistant in the department and remained there until his retirement in 1905.

Howard was advanced to captain on the Retired List in 1912; but in 1914 he rejoined for the war, serving with the Dover patrol in charge of minesweepers until 1919 and being awarded the D.S.O. in 1916. He was Mayor of the City of Canterbury in 1928–29 and died there in 1937.

CAPTAIN H. J. GEDGE, R.N.

1897–1901

Herbert James Gedge was a lieutenant of five years seniority when in 1887 he began surveying in the *Dart*, Field, later Frederick, which was engaged on surveys in Australasia, mainly the Louisiade Archipelago and the New Hebrides. After five years in the *Dart* he returned home and in 1893 joined the *Research*, Vereker, later Moore, for four years surveying in home waters.

In 1897 Gedge took command of the *Stork* and spent three years surveying in Mauritius, the Mediterranean and the Red Sea, being promoted commander in 1898. In 1899 he received Their Lordships' approbation for his searches for dangers in the Massawa Channel. In 1900 he had charge of a survey of the Tyne for six months and in the following year accepted an appointment as sub-controller of ports and lighthouses under the Egyptian Government. He retired with the rank of captain in 1904.

COMMANDER W. O. LYNE, R.N.

1901–1903

William Owen Lyne joined the *Flying Fish*, Maclear, as a sub-lieutenant in

1883, and spent four years on the China Station, being promoted lieutenant in 1885. His next appointment was the *Myrmidon*, Vereker, in 1887 working on the north-west coast of Australia. After one year, however, he transferred with Vereker to the *Rambler* on the China Station. There he remained until 1891, the last two years being under Dawson.

At the end of 1891, Lyne joined the *Stork*, Smyth, and was for two years surveying on the east coast of Africa and in the Mediterranean. Back home in 1894, he spent a few months in the *Research*, Vereker, and then went to the *Rambler*, Richards, for three years, mainly on the west coast of Africa and in the West Indies. In 1898 he was appointed to the *Triton*, Combe and later Richards, for two years on the east coast of England.

In 1900, Lyne took command of the *Waterwitch*, and for two years surveyed on the coasts of China and Borneo. He was temporarily in charge of the Shanghai division when, during the Boxer outbreak in 1900, the Senior Naval Officer left for Nanking. He then made an important survey of the north channel of the Yangtze assisted by an officer of the Chinese Customs and also aided by the manufacture of special floating beacons carried in H.M. ships. Next year he found the danger reported by the S.S. *Socotra* in the Yellow Sea approach. He retired with the rank of commander in 1907.

PAYMASTER-IN-CHIEF G. W. UNDERHILL, R.N.

1875–1893

George William Underhill was born on 29 March 1837 and entered the Navy as a master's assistant in 1852. He became a clerk in 1855, assistant paymaster in 1858, and paymaster in 1875. From 1855 to 1857 he was in the *Barracouta*, whose officers, according to Dawson, examined a harbour on the Tartary coast in 1856.

Underhill joined the department in February 1875 on a proposal by the Hydrographer that, owing to the volume and complexity of the work, a deceased writer should be replaced by a paymaster. The appointment as a naval assistant was confirmed in September of the same year, and seven years later in 1882 Underhill succeeded Blakeney as Chief Civil Assistant, acting also as secretary to the Board of Visitors of the Royal Observatory, Greenwich. In 1893 he was placed on the Retired List with the rank of paymaster-in-chief but continued to serve in the department until 1897 when failing eyesight led to his resignation. In his last year he introduced a new system of filing correspondence in the minute-books.

In 1903 Wharton supported his application for a Greenwich Hospital pension with the words: ' It would have been impossible for anyone to render better service than Mr Underhill did at the Hydrographic Department. His knowledge, zeal and capacity were of the greatest value.' Underhill's eldest son, H. H. Underhill, joined the department as a draughtsman in 1883 and became the first Assistant Superintendent of Charts in 1922.

E. J. POWELL

1852–1892

Edward James Powell joined the department as a draughtsman in November 1852 under M. Walker, chief draughtsman, and was promoted to second class in 1859. In 1864, when T. Walker resigned, the Hydrographer, Richards, put Hoskyn in his place, with Powell promoted to first class, but a year later, in June 1865, Powell was considered to have sufficient seniority to become chief draughtsman. He then had five draughtsmen under him.

In 1856 he produced a table of chart scales, which was later to be embodied in the departmental publication *Tables used in the Construction of Charts*. In 1873 he was critical of the new system that Davis had introduced for handling the original documents as compared with that of Becher. He suggested the use of coloured indexes, but they were not adopted until some ten years later.

Powell retired at the age of sixty-five in 1892.

R. C. CARRINGTON

1860–1899

Robert C. Carrington joined the department to make the fifth draughtsman in 1860 and was promoted to second class in 1864 and first class in 1874. At the end of 1874, he was released to fill the post of head draughtsman with the newly organized Marine Survey of India. He remained in India for eight years until 1882 when a review of the organization terminated his appointment.

From 1887, until he died in 1899, Carrington worked for the department but outside it. In October 1899, after Carrington's death, the Hydrographer, when asking for extra draughtsmen, said that Carrington had been exceptionally well qualified and was able to do the work of two or three ordinary draughtsmen.

Carrington prepared spheroidal tables, printed in 1887 for the department, having previously in 1873 produced a table for converting French metres into English feet and fathoms. Both were later embodied in *Tables used in the Construction of Charts*.

A. J. BOYLE

1864–1900

Augustin Joseph Boyle entered the department as a draughtsman in March 1864, and by the end of the year had been promoted to second class. He became a first-class draughtsman in 1874 and succeeded Powell as chief draughtsman in 1892, having then eight draughtsmen under him. He retired at the age of sixty-five in 1900 and was succeeded by Clark.

THE PRINCIPAL SURVEYS OF 1884

HOME

Tizard	*Triton*	England, east coast	Thames estuary, Norfolk coast, Hartlepool Bay and Harbour
		Scotland, east coast	Montrose and Arbroath Harbours, Lunan Bay
Archdeacon	*Knight Errant* h.v.*	England, west coast	Morecambe Bay, Bristol Channel

FOREIGN

Maxwell	*Gulnare*, h.v.	Newfoundland	South coast
White	*Sparrowhawk*	West Indies	Little Bahama Bank
Wharton, Aldrich	*Sylvia*	South America	Magellan Strait
		South Africa	Cape St Lucia to Delagoa Bay
Carpenter, Hoskyn	*Myrmidon*	Red Sea	Sawakin (Suakin) and approaches, Port Berenice, Hanish Island, Zeila
Vereker	*Magpie*	Malacca Strait	Penang to Sayer Island, Bass Harbour
Maclear	*Flying Fish*	China coast	Amoy, Haitan Strait, Korea west coast
Coghlan	*Meda*	Australia, north coast	Shark Bay, Cambridge Gulf, Port Denison
Oldham	*Lark*	New Zealand	Auckland Harbour
		South Pacific	Solomon Islands, Bougainville Strait
Moore	*Dart*	Tasmania	Spring Bay
		West Pacific	Cruise
		New Guinea	South coast

BY THE MARINE SURVEY OF INDIA

Dawson, Carpenter	*Investigator*	Burma	Rangoon, Ramree Harbour
		India	Madras and Hindustan coasts

FOR THE DOMINION GOVERNMENT OF CANADA

Boulton	CANADIAN LAKES	Georgian Bay (Lake Huron)

Triton also searched for reported shoal water south-west of Ushant without result.

Sylvia completed the important Magellan Strait route begun by Mayne in 1865. Aldrich joined at the Cape in May.

Myrmidon left England in February. At Suakin, constant assistance was given to the troops repelling night attacks on our lines. Hoskyn succeeded Carpenter in October.

Magpie arrived home in June and was put out of commission. *En route* she had visited Diego Garcia coaling-station and she left Lieutenants Belam and Douglas to survey Penang anchorage at the Colonial Office's request.

Flying Fish worked with Korean Government permission, cordially granted. Maclear found the Koreans very civil, courteous and honest but tryingly inquisitive; and he reported fully on the trade of the country when the survey was concluded in October.

Lark's surgeon, Guppy, made a geological survey of Treasury Island, as already mentioned.

Dart's work was done during voyages as a cruiser, her duties in New Guinea being principally concerned with the establishment of the British protectorate.

Investigator had detached parties under Channer, Smyth and Pascoe; and Carpenter succeeded Dawson in November.

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* h.v. = hired vessel.

THE PRINCIPAL SURVEYS OF 1885

HOME

Tizard	*Triton*	England, east coast Scotland, east coast	Dover Bay, Goodwin Sands, Norfolk coast The Tay, Pentland Firth streams
Archdeacon	*Knight Errant*, h.v.	England, west coast	Bristol Channel, Cardiff and Penarth roads for the new Barry docks

FOREIGN

Maxwell	*Gulnare*, h.v.	Newfoundland Canada, east coast	South coast New Brunswick coast, Shediac Harbour, St Lawrence south channel
White, Oldham	*Sparrowhawk*	West Indies	Little Bahama Bank
Aldrich	*Sylvia*	Mediterranean	Gibraltar Bay, Malta Channel, Skerki Bank
Hoskyn	*Myrmidon*	Red Sea Eastern Archipelago Australia, north coast	Perim Harbour, Hanish Island channel Wetta Passage, Timor Islands Port Darwin
Vereker	*Rambler*	Red Sea Indian Ocean China coast	Trinkitat Diego Garcia Hong Kong to Shanghai salient points, Min River to Hungwha Channel including Haitan Island, Hong Kong Harbour
Maclear	*Flying Fish*	Eastern Archipelago	China to Australia trade route, Banka and Mindoro Straits
G. E. Richards	*Paluma*	Australia, east coast	Queensland inner route, Whitsunday Passage
Coghlan	*Meda*	Australia, north coast	La Grange and Shark Bays, Dampier Archipelago to North-west Cape searching for dangers

Pullen	*Lark*	AUSTRALIA, EAST COAST NEW GUINEA	Sydney Harbour, Stacey Island Port Moresby
Field	*Dart*	NEW GUINEA	Trobriand Island, Dart Reef 17°S, 148°E
Belam, Douglas		MALAY PENINSULA	Perak River, Singapore western approaches

BY THE MARINE SURVEY OF INDIA

Carpenter	*Investigator*	BAY OF BENGAL, BURMA	Dhamra River, Kyaukpyu, Tavoy River, Mergui Harbour
		INDIA, EAST COAST	Rajpuri Island, Bhaunagar Creek

FOR THE DOMINION GOVERNMENT OF CANADA

Boulton		CANADIAN LAKES	Georgian Bay (Lake Huron)

Several ships were delayed by the strained relations with Russia, and *Flying Fish* was rearmed as a cruiser for several months.

In *Sylvia* at Gibraltar a meridian distance from Greenwich with the cooperation of the Eastern Telegraph Company was not completely successful. Graham Shoal in Malta Channel, an island formed in 1831 from a volcanic eruption and which had eighteen feet over it in 1870, now carried four fathoms. As its surface was bare rock the depth was thought unlikely to increase further.

Rambler, successor to *Magpie*, left England in January and called at Malta to examine the results of mining operations to remove shoal heads off St Elmo. Vereker was succeeded by Moore at the end of a remarkable year's work.

Paluma charted 133 miles of coast and sounded an area of 2 100 square miles, no mean achievement for a gunboat riding so low in the water that in rough seas her decks were constantly flooded.

Investigator was ordered to Rangoon in October and, as has been mentioned on p. 117, Carpenter led a flotilla of the Burma Field Force up the Irrawaddy to Mandalay. He made a sketch survey of the river over the whole distance.

THE PRINCIPAL SURVEYS OF 1886

		HOME	
Tizard	*Triton*	ENGLAND, EAST COAST	The Thames and the Medway, Norfolk coast
Archdeacon	*Knight Errant*, h.v.	ENGLAND, WEST COAST	Bristol Channel, Carmarthen Bay
		FOREIGN	
Maxwell	*Gulnare*, h.v.	CANADA, EAST COAST	The St Lawrence—the Traverses
Oldham	*Sparrowhawk*	SOUTH AMERICA	British Guiana—approaches to the Demerara and the Essequibo Rivers
Dawson	*Sylvia*	AFRICA, WEST COAST SPAIN, WEST COAST	Gambia River 100-fathom line
Moore	*Rambler*	CHINA COAST	Hong Kong to Shanghai salient points, the Yangtze, Haitan Island to Min River
Maclear	*Flying Fish*	EASTERN ARCHIPELAGO AUSTRALIA, NORTH COAST	Mindoro Strait
Hoskyn	*Myrmidon*	AUSTRALIA, SOUTH COAST SOUTH PACIFIC	Bass Strait Coral Sea, Flora Pass
G. E. Richards	*Paluma*	AUSTRALIA, EAST COAST	Queensland inner route
Pullen	*Lark*	NEW GUINEA AUSTRALIA, EAST COAST	South coast Great Barrier Reef, Lark Pass
Field	*Dart*	TASMANIA SOUTH PACIFIC	D'Entrecasteaux Channel China Strait, New Hebrides
Coghlan	*Meda*	AUSTRALIA, WEST COAST	Fremantle north channel

BY THE MARINE SURVEY OF INDIA

Carpenter	*Investigator*	BURMA	Mergui Archipelago
		INDIA, EAST COAST	Gulf of Cambay

FOR THE DOMINION GOVERNMENT OF CANADA

Boulton		CANADIAN LAKES	Georgian Bay (Lake Huron)

Triton's surveys covered Haisborough Sand and Hammonds Knoll; there was some shoaling since the survey of 1828–30. An officer was sent to verify the measured-mile beacons at Gare Loch.

Knight Errant's Bristol Channel work was of Upper King Road.

Gulnare completed the Traverses, finding changes since Bayfield's survey of 1827.

Sylvia observed many meridian distances, including Cape Verde Island to Dakar with the help of a new submarine cable. On arrival at Malta a telegraphic connexion with Gibraltar was obtained, and a start made with the observation of a true bearing of Mount Etna from the palace tower in Valetta.

Rambler was assisted by the Imperial Customs cruiser *Kua Hshing* in which Purey-Cust sounded the south channel of the Yangtze near Kiu Toan lightship.

Flying Fish's surveys included the Dundas and Clarence Straits, a passage now becoming much used. She left Port Darwin for England in November, and among other investigations called at Christmas Island as already mentioned.

Egeria was commissioned to relieve her, and at the end of the year was approaching Ceylon.

Myrmidon's surveys were concerned with safe tracks in the Coral Sea and passages through the Great Barrier Reef. They settled a long-vexed question of dangers reported by Bougainville in 1768.

Meda was paid off at the end of the season and her surveys were to be continued when a surveying ship became available.

In this year the Marine Survey of India had five naval officers, eight Indian Marine officers, and two native surveyors. Various work was done with detached parties.

THE PRINCIPAL SURVEYS OF 1887

HOME

Tizard	*Triton*	England, east coast	The Thames and the Medway, Harwich Harbour, Norfolk coast
Archdeacon	*Knight Errant*, h.v.	England, west coast England, east coast North Sea	Bristol Channel Goodwin Sands Heligoland

FOREIGN

Maxwell	*Gulnare*, h.v.	Canada, east coast	The St Lawrence—the Traverses to Quebec
Havergal	*Sparrowhawk*	South America West Indies	British Guiana St Lucia
Dawson	*Sylvia*	Mediterranean Red Sea	Smyrna, Gulf of Volos Avocet Rock
Moore	*Rambler*	China coast Borneo	Chusan Archipelago, Hong Kong Harbour Brunei River approach
Maclear	*Flying Fish*	Indian Ocean Red Sea	Christmas Island, searches for vigias Avocet Rock
Aldrich	*Egeria*	Ceylon Indian Ocean	East coast Christmas Island, Mauritius
Hoskyn	*Myrmidon*	Australia, south coast Australia, east coast	Bass Strait Coral Sea and Great Barrier Reef passages
G. E. Richards	*Paluma*	Australia, east coast	Queensland inner route, Port Denison
Field	*Dart*	Tasmania South Pacific	D'Entrecasteaux Channel Louisiade Archipelago
Pullen	*Lark*	Australia, east coast	Sydney Harbour

BY THE MARINE SURVEY OF INDIA

Carpenter	*Investigator*	INDIA, EAST COAST	Madras coast, approaches to Chittagong
		BURMA	Malabar and Tenasserim coasts
		BAY OF BENGAL	Andaman Islands

FOR THE DOMINION GOVERNMENT OF CANADA

Boulton		CANADIAN LAKES	Northern shore of Lake Huron

Knight Errant laid buoys for the review at Spithead and attended with *Triton.* The latter's survey included the Dudgeon Shoal which had not altered. Before the review, *Knight Errant* made a thorough resurvey of Heligoland and approaches, afterwards visiting Littlehampton, Shoreham, and Newhaven. Her survey of the Goodwin Sands found that after moving eastward from 1795 to 1864 it was again swinging to the westward.

Sylvia left Smyrna when Turkish permission for her surveys was withdrawn and went to the Gulf of Volos. On account of the sickly condition of her ship's company she joined the Commander-in-Chief for an inspection at Cattaro where some of her men were changed before she went to the Red Sea and failed, in bad weather, to find Avocet Rock.

Rambler was assisted this year by a Chinese war-sloop lent by the Viceroy of Kiangsi for work in the Chusan Archipelago.

The visits of the *Flying Fish* and *Egeria* to Christmas Island have been mentioned earlier. The former also failed to find Avocet Rock on her way home, where she arrived in May to be paid off.

Dart had to return to Sydney for docking after touching ground, and her report commented on the considerable difficulties in the Louisiade Archipelago from trade winds, strong currents, intricate reefs, and the anchorage problem among steep-sided coral-islands.

Lark was found unseaworthy in February, and her officers returned home.

Investigator did useful oceanographic work in the Bay of Bengal.

THE PRINCIPAL SURVEYS OF 1888

HOME

Tizard	*Triton*	England, east coast	Thames estuary, Humber approaches
Archdeacon	*Knight Errant*, h.v.	Ireland, south coast England, west coast	Cork Harbour North coast of Wales, river Dee

FOREIGN

Maxwell	*Gulnare*, h.v.	Canada, east coast	The St Lawrence, Quebec to Goose Cape
Havergal	*Sparrowhawk*	West Indies	St Lucia, St Vincent
Dawson	*Sylvia*	Red Sea Mediterranean	Jebel Teir, Zebayir and Zuku Islands Gulfs of Volos and Corinth
Pullen	*Stork*	Red Sea Africa, east coast	Avocet Rock River Umba and Kilifi, Mombasa approaches
Moore	*Rambler*	Borneo China Coast	Brunei approaches Chusan Archipelago
Aldrich	*Egeria*	Pacific cruise	New Zealand to Sandwich Islands and Fiji
Hoskyn, Vereker	*Myrmidon*	Tasmania Australia, north coast	North coast Cambridge Gulf
G. E. Richards	*Paluma*	Australia, east coast	Queensland coast and Great Barrier Reef
Field	*Dart*	Tasmania South Pacific	Hobart approaches Louisiade Archipelago

BY THE MARINE SURVEY OF INDIA

Carpenter	*Investigator*	Bay of Bengal Burma	Andaman Islands Malabar coast

FOR THE DOMINION GOVERNMENT OF CANADA

Boulton	CANADIAN LAKES	Northern shore of Lake Huron

Triton re-sounded Duke of Edinburgh, Alexandra, Princes, and Knob Channels, finding that the central patch in the first had shoaled to 22 feet. It had first been found in 1882.

Gulnare's work was at joint expense of Imperial and colonial Governments.

Sylvia also sounded Port Said approaches, finding little change since the 1877 survey so that the rapid diminution of depth north and west of the western breakwater had ceased. The ship paid off at Sheerness early in 1889 after surveying for seven years.

Stork, commissioned at Chatham in February by Pullen, found Avocet Rock by following up an indication reported by *Sylvia* in 1887. Her work in East Africa covered the river Umba boundary between the British and German spheres of influence.

Rambler lent assistance to the North Borneo Company in the defence of Mempakul. A report was made on the eagre or bore of the Tsientang-kiang.

Egeria's search for Pelorus Reef reported in 1861 was aided by large patches of organic matter on the surface; and the annual report discusses this phenomenon.

Myrmidon and her boats could not stem the currents at strength in the Adolphus Channel owing to the condition of their engines. At the end of the year the ship returned to pay off and transfer her crew to *Rambler* at Hong Kong. Vereker had succeeded Hoskyn in April.

Dart, during her two years work in the Louisiade Archipelago, had no difficulty with the natives, who had borne an evil reputation. Some savages served as supernumeraries to the satisfaction of the officers, and left the ship much to their own regret.

THE PRINCIPAL SURVEYS OF 1889

HOME

Aldrich	*Research*	ENGLAND, SOUTH COAST	Falmouth Harbour and approaches, English Channel south-west approach
Tizard	*Triton*	ENGLAND, EAST COAST	Thames estuary—sandbanks and channels
Archdeacon	*Knight Errant*, h.v.	IRELAND	Lough Foyle, Dublin Bay
		ENGLAND, EAST COAST	Cardigan Bay
		ENGLAND, SOUTH COAST	Whitsand Bay measured mile

FOREIGN

Maxwell	*Gulnare*, h.v.	CANADA, EAST COAST	Halifax (Nova Scotia)
		NEWFOUNDLAND	South coast
Havergal	*Sparrowhawk*	WEST INDIES	St Vincent
Pullen, Balfour	*Stork*	AFRICA, EAST COAST	Pemba Island, Melinda, Zambezi delta
Vereker, Dawson	*Rambler*	CHINA SEA	Pratas Island
		BORNEO	North coast
		AUSTRALIA, NORTH COAST	Cambridge, Albany, King George Sound
Oldham	*Egeria*	PACIFIC OCEAN	Deep-sea cruise—Australasia to Canada
Pirie	*Paluma*	AUSTRALIA, EAST COAST	Queensland, Cooktown to Cape Flattery
Frederick	*Dart*	AUSTRALIA, EAST COAST	Queensland inner route
Pullen		AFRICA, WEST COAST	Meridian distances

BY THE MARINE SURVEY OF INDIA

Carpenter, Hoskyn	*Investigator*	INDIA, EAST COAST	Orissa coast
		BAY OF BENGAL	Andaman Islands,
		INDIAN OCEAN	Lakadivh (Laccadive) Islands

FOR THE DOMINION GOVERNMENT OF CANADA

Boulton	Canadian lakes	Northern shore of Lake Huron

Research, specially built for surveying (see p. 138), was commissioned by Aldrich at Chatham in April. Her important survey in the south-west approaches to the Channel found an unexpected bottom configuration.

Triton found shoaling in the Edinburgh Channel but the banks following the main line of the tidal streams had not altered much.

Gulnare found Lamb Rock, as mentioned on p. 140.

Sparrowhawk was found unfit and paid off in May.

Stork was concerned with the boundary between British East African Company's territory and that under German protection near Kipini. Balfour succeeded Pullen at the Cape in June.

On the Zambezi, *Stork* reached Chinde and a steam whaler with other boats then took H. H. Johnson, H.B.M. Consul, to Morambala on the river Shire.

Rambler was manned by Vereker and the crew of *Myrmidon* in February at Hong Kong and Dawson took over command at Thursday Island in May. The dredging of Princess Royal Harbour, King George Sound, was under consideration.

Egeria's cruise took her to many groups of islands on the projected cable route and the British flag was hoisted in the Union and Phoenix groups. Lister was embarked as naturalist. Several vigias were disproved.

In the *Dart* Frederick succeeded Field in March. Many dangers were found in the inner route.

Pullen's death on the west coast of Africa has been recorded on p. 143. His orders included surveys of the Rio-del-Rey for the Anglo-German boundary when the healthy season commenced in December, but he made a preliminary visit to Bonny in October where he succumbed to fever on 3 November.

THE PRINCIPAL SURVEYS OF 1890

HOME

Aldrich	*Research*	ENGLAND, SOUTH COAST	English Channel south-west approach, Falmouth and Exmouth Bays
Tizard	*Triton*	ENGLAND, EAST COAST	Thames estuary Great Nore, Blyth, Humber and Harwich approaches
Archdeacon	*Knight Errant*, h.v.	ENGLAND, WEST COAST	Solway Firth, Cardigan Bay
		SCOTLAND, WEST COAST	Firth of Clyde

FOREIGN

Maxwell	*Gulnare*, h.v.	CANADA, EAST COAST	Halifax (Nova Scotia)
		NEWFOUNDLAND	South coast and Belle Isle Strait
Balfour	*Stork*	AFRICA, EAST COAST	Melinda to Chale Point
		AFRICA, SOUTH COAST	Simons Bay
		INDIAN OCEAN	Seychelles Islands
Dawson	*Rambler*	AUSTRALIA, NORTH COAST	Torres Strait
		CHINA COAST	Chusan Archipelago
Oldham	*Egeria*	SOUTH PACIFIC EASTERN ARCHIPELAGO	Deep-sea sounding cruises and searches for vigias
Moore	*Penguin*	RED SEA	Gulf of Suez, Suakin and Zebayir Islands shoal-water examinations
		AUSTRALIA, NORTH COAST	Cape Bougainville vicinity
Pirie	*Paluma*	AUSTRALIA, EAST COAST	Cape York, Adolphus Islands, Queensland coast
Frederick	*Dart*	SOUTH PACIFIC	New Hebrides group

BY THE MARINE SURVEY OF INDIA

Hoskyn	*Investigator*	INDIA, EAST COAST	Orissa and Madras coasts
		BURMA	Bassein River
		BAY OF BENGAL	Northern Andaman Islands

FOR THE DOMINION GOVERNMENT OF CANADA

Boulton		CANADIAN LAKES	Northern shore of Lake Huron

Research experienced much heavy weather in the Channel approaches. She rode out more than one westerly gale anchored in 75 fathoms with little strain or injury to the ship, though with great discomfort to those on board.

Triton also took tidal-stream observations in the Dover Strait. Blyth Harbour was being greatly improved by dredging. There were surveys of Medway reaches.

Knight Errant found the new Warden Bank in the Clyde to have 5¾ fathoms and thus present no danger to navigation.

Stork was docked by private contract at Cape Town in May, and her officers continued the survey of Simons Bay with the help of boats and men from the flagship and other men-of-war. At the end of the year she left the Seychelles for Malta and recommissioning.

Egeria's cruises took her to Auckland, Tonga group, New Hebrides, Thursday Island, Surabaja and Singapore where she arrived in November. Field relieved Oldham and sailed for Hong Kong via Labuan and Manila.

Penguin was commissioned in January and left home for Australia via Suez in February. On the north-west coast of Australia the survey was an unpleasant and monotonous piece of work in intricate waters lacking marks; and the natives were implacably hostile. The latter interfered with the natural-history collections of the chief engineer, Walker. On passage an interesting local magnetic anomaly was measured at Bezout Island, and at Fremantle a telegraphic meridian distance from Adelaide was successfully observed.

Paluma made a report on Cairns as a possible coaling-station.

Investigator detached a boat party under Lieutenant Gunn to examine the river entrances at the head of the Persian Gulf.

THE PRINCIPAL SURVEYS OF 1891

HOME

Vereker	*Research*	England, south coast	Needles Channel, Brownsea Road (Poole) river Exe
		Ireland, north coast	Approaches to North Channel
		Scotland, west coast	Oban Bay
Tizard, Maxwell	*Triton*	Scotland, west coast	Lamlash Harbour, Campbeltown Loch
		England, west coast	The Skerries (Angelsey) Cardigan Bay

FOREIGN

Tooker	*Gulnare*, h.v.	Canada, east coast	Halifax Harbour, Nova Scotia
		Newfoundland	South coast and Belle Isle Strait
Smyth	*Stork*	Red Sea	Mohabbakah Island to Bab-el-Mandeb Strait
		Africa, east coast	Formosa Bay, Seychelles Bank
Dawson	*Rambler*	Red Sea	With *Stork* on passage home
Field	*Egeria*	China Sea	Vereker Bank and Sulu Sea soundings
		Borneo	Darvel Bay
Moore	*Penguin*	Australia, north coast	Off Capes Voltaire and Bougainville
Pirie	*Paluma*	Australia, east coast	Adolphus Channel southwards, Queensland
Frederick	*Dart*	Tasmania	Tasman Peninsula
		South Pacific	New Hebrides group

BY THE MARINE SURVEY OF INDIA

Hoskyn	*Investigator*	India, east coast	Madras coast
		Indian Ocean	Lakadivh Islands, Minikoi Island

FOR THE DOMINION GOVERNMENT OF CANADA

Boulton	CANADIAN LAKES	Eastern shore of Georgian Bay (Lake Huron)

Ships abroad were unavoidably short of surveying officers.

Research had most unpropitious weather off the northern coasts of Ireland, where the survey was much needed in the interests of modern traffic to guide vessels in foggy weather.

Triton found alterations in Thames estuary channels. At Harwich her examination of Languard Point showed that no action was necessary to extend the groynes placed to arrest the movement of shingle. In May, Maxwell succeeded Tizard who had commanded since 1882.

Knight Errant's survey of Lamlash was on a large scale to meet the anchorage needs of large squadrons of H.M. ships, and a pinnacle rock unknown to fishermen was found. The Skerries survey constantly exposed the ship to danger and a new shoal depth was promptly buoyed by Trinity House.

Gulnare successfully used oil to prevent seas breaking on board when searching for a bank in Cabot Strait.

Stork showed the great extent of the Seychelles Bank.

Rambler and *Stork* were assisted by H.M.S. *Kingfisher* in the Red Sea. *Rambler* was paid off at Chatham in July after seven years' surveying.

Egeria cooperated with the Netherlands Navy in fixing the British/Netherlands boundary in Borneo, commencing at latitude 4° 10′ N. This is referred to on p. 142.

Penguin's results were disappointing as regards the prospect of shortening the coastal routes. Banks reported by Flinders in 1803 and the *Fly*, Blackwood, north of Darwin were resurveyed. The ship's surgeon, Bassett-Smith, and engineer, Walker, devoted all their leisure to collecting natural-history specimens as already mentioned.

Dart in the New Hebrides found the presence of Presbyterian missions a great help, both in cases of sickness and the influence on the formerly barbarous natives. Officers and men mixed with the natives in perfect confidence and visited villages where no white men had been before.

THE PRINCIPAL SURVEYS OF 1892

HOME

Vereker	*Research*	England, south coast	Southampton Water
		Ireland, north coast	Approaches to North Channel
		Scotland, west coast	Oban Bay, the Hebrides
Maxwell	*Triton*	England, east coast	The Shipwash and Silver Pits, Thames estuary, Bridlington Bay
Archdeacon	*Knight Errant*, h.v.	England, west coast	Carnarvon Bay, Menai Strait approach
		Ireland, east coast	Kingstown Harbour

FOREIGN

Tooker	*Gulnare*, h.v.	Canada, east coast	Halifax (Nova Scotia), Anticosti Island vicinity
Smyth	*Stork*	Africa, east coast	Lamu Bay
		Mediterranean	West coast of Greece
Field	*Egeria*	China Sea	Pratas Island vigia, Anambas Islands
		Borneo	North-east coast
Moore	*Penguin*	China Sea	Macclesfield Bank, Chusan Archipelago
Pirie	*Paluma*	Australia, east coast	Queensland inner route, Cape Grenville to Orfordness
Purey-Cust	*Dart*	South Pacific	New Hebrides group

BY THE MARINE SURVEY OF INDIA

Oldham	*Investigator*	India	Bombay Harbour, east coast of Hindustan
		Indian Ocean	Lakadivh Islands

FOR THE DOMINION GOVERNMENT OF CANADA

Boulton		Canadian lakes	Eastern shore of Georgian Bay (Lake Huron)

In the approach to the Irish Channel, *Research* was hampered by fogs and misty weather instead of the gales of the previous year, and while at anchor at night there was danger of being run down by passing ships.

Triton again found decreased depths in the Duke of Edinburgh Channel, so that the annual report commented: 'Whether the channel will be finally reclosed, or whether the shoal will be arrested in its concretion, time only can show.'

Knight Errant made a large-scale examination of Kingstown, used by H.M. ships in reserve. During the season, Archdeacon's health broke down from the exposure of many years' surveying on the coast of England and on various foreign stations. He died early in 1893.

Gulnare's survey of the east coast of Anticosti proved that dangers off this inhospitable coast were no further off than charted. The loss of 54 vessels in twenty years appeared mainly due to the disregard of proper precautions in thick weather.

Stork found in the fairway off Platea a rock with 26 feet in 20 fathoms, named Day Rock after a lieutenant on board, and it was astonishing that none of the Mediterranean Squadron had struck it when exercising.

Egeria laid beacons in 180 fathoms when searching for Hossack Shoal 47 miles NNE of the Pratas, only to have them swept away by gales. 900 square miles were searched with negative result. The Anambas group rounded by all vessels on their way to Singapore from China was comprehensively triangulated.

Penguin examined Macclesfield Bank carefully. About the east coast of China, the annual report said: 'Operations have demonstrated the remarkable growth . . . the natives industriously reclaiming land from the sea by strong walls; islands are becoming part of the main.' As before, Bassett-Smith and Walker made extensive scientific collections including corals from Macclesfield Bank.

Dart was recommissioned by Purey-Cust at Sydney in April.

In India, Hoskyn died in January and Gunn took charge until Oldham's arrival.

In Canada the Georgian Bay work was almost completed and Boulton returned home in 1893.

THE PRINCIPAL SURVEYS OF 1893

HOME

Vereker	*Research*	England, south coast	Spithead eastern approach, dredged channel to Portsmouth Harbour
G. E. Richards	*Triton*	England, east coast	Thames estuary, Filey Bay, outer approaches to the Humber
Maxwell	*Knight Errant*, h.v.	England, west coast	English and Welsh Grounds, Bristol Channel, Ilfracombe, Carnarvon Bay
		Ireland, east coast	Wexford Harbour and Bar
Haslewood	Hired launch	England, south coast	Plymouth Sound

FOREIGN

Tooker	*Gulnare*, h.v.	Newfoundland	Isthmus Bay
Smyth	*Stork*	Mediterranean	Malta and Gozo, Boghaz Pass (Alexandria)
Field	*Egeria*	China Sea	Hong Kong approach, Macclesfield Bank, Anambas Islands
		Malacca Strait	Triangulation of Malayan shore
Moore	*Penguin*	Australia, north coast	Torres Strait examinations
		South Pacific	Solomon Islands
Balfour, Pirie, Heming	*Paluma*	Australia, east coast	Queensland inner route
		Australia, north coast	Torres Strait approaches
Purey-Cust	*Dart*	Tasmania	Tasman Peninsula—Port Arthur
		South Pacific	New Hebrides group

BY THE MARINE SURVEY OF INDIA

Oldham	*Investigator*	India	Coromandel coast, Bombay Harbour
		Indian Ocean	Lakadivh Islands

The annual report mentions that ships were employed on one piece of work, little time being spent in moving about from one place to another, as formerly.

Research closely examined the new 24-foot dredged channel into Portsmouth.

Triton's survey of the Duke of Edinburgh Channel showed no decrease in depth on Shingles Patch, a name used for the first time.

Haslewood originated what was to become known as the south-coast-of-England survey, responsible for annual maintenance work at Portsmouth, Devonport, and so on.

Stork made a careful large-scale survey of the new ' Straight Boghaz Pass ' using divers and dragging a submerged framework through the whole length of the channel on parallel lines 15 feet apart.

Egeria completed the Macclesfield Bank with Bassett-Smith of the *Penguin* embarked as a volunteer for adding to his collection of coral samples. Coal was sent in junks towed by gunboats. In Malacca Strait a triangulation between Cape Rachado and Selangor was completed and a survey made of the river Klang where wharves were projected.

Penguin found the natives of the Solomon Islands, despite their reputation, friendly and obliging, supplying parties with fruit, yams, and the like. The evidence that a surveying ship intended ' no harm to them or their institutions invariably dispelled the natural suspicions with which the savage regards the white man '.

Paluma was, as mentioned on p. 141, put high and dry in Brisbane botanical gardens by floods in February, and only escaped destruction by the skill and energy of those on board. A second unprecedented rise of the river refloated her fifteen days later. Heming relieved Pirie in May. The Queensland Government authorized a pecuniary reward to pearlers who marked a discovered rock.

Investigator detached a party under C. V. Smith to sound over the Seychelles Bank for a telegraph cable, which was laid between Zanzibar, Seychelles, and Mauritius.

THE PRINCIPAL SURVEYS OF 1894

HOME

Vereker	*Research*	England, south coast	Spithead
G. E. Richards, Pirie	*Triton*	England, east coast	Humber and approach, Whitby, Bridlington Bay, river Medway, Thames estuary
Maxwell	*Gladiator*, h.v.	England, west coast Ireland, east coast	Pembroke Reach, Menai Strait approach Wexford Harbour
Haslewood	Hired launch	England, south coast	Plymouth Sound

FOREIGN

Tooker	*Gulnare*, h.v.	Newfoundland	Cape St George to Long Point
Simpson	*Stork*	Mediterranean	Malta and Gozo, Port Argostoli
Field	*Egeria*	Indian Ocean Red Sea	Maldive Islands Perim Island, Hanish Island vicinity
Balfour	*Penguin*	Australia, east coast South Pacific	Jervis Bay Solomon Islands—New Georgia
Heming	*Paluma*	Australia, east coast	Queensland inner route
Purey-Cust	*Dart*	Tasmania South Pacific	Tasman Peninsula New Hebrides group
Combe	*Waterwitch*	Africa, west coast	Benguela, Great Fish and Walfisch Bays

BY THE MARINE SURVEY OF INDIA

Oldham	*Investigator*	India Ceylon	Coromandel coast North coast

Triton found the Hull Middle Shoal had increased, so that there was no berth for a first-class battleship off Hull. Pirie succeeded Richards in July.

Gladiator proved the chart correct west of the Eddystone on which S.S. *Dunottar Castle* had stranded, representing that deeper water than charted existed to the westward.

Stork was recommissioned at Malta in February by Simpson. Several rocks were found off the coast of the Maltese islands.

Egeria had been in commission more than four years when she left Penang in March. She paid off at Chatham in June after eight years' surveying.

Paluma discovered some important dangers off Eel Reef southward of Cape Grenville. She was paid off and returned to the Queensland Government at the end of the year.

Dart in the New Hebrides was at hand when there was a violent volcanic eruption on Ambrym Island. Lava streams entered the sea close to the ship; steam and dust stopped surveying work and assistance was given to the natives.

Waterwitch, formerly the steam yacht *Lancashire Witch*, was commissioned at Portsmouth in June by Combe for the Australia Station. *En route* to Las Palmas she examined Dacia Bank. Between Sierra Leone and Benguela, deep-sea soundings and current observations in the Guinea-current and Equatorial-current were taken. A plan of Benguela was made at Portuguese request.

Rambler was commissioned at Chatham in November by G. E. Richards for service on the North America Station.

In *Investigator* the appointment of two assistants of the Royal Navy's surveying service terminated, and the survey was carried on by Royal Indian Marine officers only, under Oldham.

THE PRINCIPAL SURVEYS OF 1895

HOME

Moore	*Research*	SHETLAND ISLANDS ORKNEY ISLANDS	Offshore soundings Kirkwall
Pirie	*Triton*	ENGLAND, EAST COAST	The Thames and estuary, Norfolk coast
Maxwell	*Gladiator*, h.v.	IRELAND, WEST COAST ENGLAND, WEST COAST	Berehaven, Tralee Bay Holyhead, Great Ormes Head
Haslewood	Hired launch	ENGLAND, SOUTH COAST	Plymouth and Portland

FOREIGN

Tooker	*Gulnare*, h.v.	NEWFOUNDLAND	Bonne Bay
Simpson	*Stork*	MEDITERRANEAN	Gulfs of Corinth and Patras, Gibraltar roads
G. E. Richards	*Rambler*	AFRICA, WEST COAST CANADA, EAST COAST WEST INDIES	Sherbro River Halifax approaches (Nova Scotia) The Narrows (Bermuda)
Balfour	*Penguin*	SOUTH PACIFIC	Solomon Islands, Samoa and Namuka groups
Combe	*Waterwitch*	SOUTH PACIFIC	Fiji Islands sounding for telegraph cables
Purey-Cust, Heming, Glennie	*Dart*	AUSTRALIA, EAST COAST	Queensland inner route

BY THE MARINE SURVEY OF INDIA

Oldham	*Investigator*	INDIA CEYLON	Mouths of the Indus Palk Strait

Research first found that the dredging of Portsmouth inner bar had left a remarkably even bottom. In the Shetlands she finished off-shore sounding, left for many years incomplete.

Triton found changes off Yarmouth and Lowestoft so that it was difficult to recognize the banks compared with the 1885 survey.

Gladiator resurveyed parts of Berehaven but the general completeness of Wolfe's survey of 1844 appeared to render a full resurvey unnecessary.

Gulnare at Bonne Bay was modernizing a chart based on the surveys of Cook in 1764, 'excellent in character'.

Stork's work at Gibraltar was in consequence of the extensive harbour works contemplated on the west side of the Rock, and in order that the breakwaters might be so planned as to include the greatest available anchorage space.

Rambler, commissioned again in November 1894, did useful work at the Sherbro River so that it could be buoyed by the Sierra Leone Government to meet the increasing trade.

Penguin and *Waterwitch* took many deep-sea soundings with the laying of telegraph cables in mind. The former brought up bottom-samples from two soundings of 5 150 fathoms eastward of a line joining the Friendly and Kermadec Islands. The previous greatest depth was 4 655 fathoms north-east of Japan in 1875 by U.S.S. *Tuscarora*, and the annual report adds: 'They furthermore confirm the fact, before observed, that the deepest parts of the sea are not far from land.'

Dart was recommissioned by Heming in May, but two months later he lost an eye in an accident. Glennie assumed command temporarily and lost an officer, Lieutenant Rathbone, in October as the result of an accident with a pistol. *Dart* was taking up the work of the *Paluma*. Howard arrived to take command in December.

Investigator was assisted by the small steam vessel *Nancowry*.

THE PRINCIPAL SURVEYS OF 1896

HOME

Moore	*Research*	England, south coast Scotland, east coast Orkney Islands	Newhaven Firth of Forth Kirkwall
Pirie	*Triton*	England, east coast	The Medway, Goodwin Sands, Edinburgh Channel (Thames estuary)
Maxwell	*Gladiator*, h.v.	Ireland	Berehaven, Killary Bay, Dungarvan, Westport, Carlingford Lough
Haslewood	Hired launch	England, south coast	Portsmouth, Prince Consort Shoal (Cowes)

FOREIGN

Tooker	*Gulnare*, h.v.	Newfoundland	West coast northward of Bonne Bay
Simpson	*Stork*	Mediterranean	Gulfs of Corinth and Patras
G. E. Richards	*Rambler*	West Indies Canada, east coast	Belize, Bermuda Channels Halifax approaches, Louisburg (Nova Scotia)
Balfour, Field	*Penguin*	South Pacific	Ellice group, Suva, Funafuti Atoll
Combe	*Waterwitch*	Tasmania South Pacific	Tasman Peninsula Fiji Islands
Howard	*Dart*	Tasmania Australia, east coast	Tasman Peninsula, Wedge Bay Queensland inner route

BY THE MARINE SURVEY OF INDIA

Oldham	*Investigator*	Indian Ocean	Sind coast, Andaman Islands

Research, by arrangement with the Royal Society and the Fishery Board for Scotland, spent some weeks in the Faeroe Channel taking temperatures and water-samples and experimenting with Dr G. H. Fowler's apparatus for collecting living forms from definite depths. Currents, using an improved Pillsbury meter, were also measured.

Triton found considerable changes in the Goodwins since the 1887 survey. The general movement towards the coast had continued and areas of drying sand had largely increased. The Shingles Patch in the Duke of Edinburgh Channel was twice sounded over during the year.

Penguin was recommissioned by Field at Sydney in March. Much of the season was spent in transporting and assisting a boring party and their equipment, which, under Professor Sollas of the Royal Society, aimed at elucidating the structure of coral formations. Two sites were tried on Funafuti Atoll but no greater penetration than 100 feet was attained. Meanwhile, the ship ran sections to determine the contours to a distance of 8 miles from the reef and depths of 2 000 fathoms round it. Nukulailai group was also scientifically examined. Various vigias were examined on passages.

Waterwitch spent three weeks searching for La Brillante Shoal, 23° S, 170° E, without obtaining a lesser depth than 1 190 fathoms. The report said: ' This supposed shoal, which has long been a bugbear to navigation, and is in the line of the new mail route from Fiji to Australia, has consequently now been expunged from the Admiralty charts.'

Dart, on the other hand, proved the existence of Pearn Rock which had been reported in the inner route in 1876, and after several fruitless searches was believed not to exist.

Referring to the work in the south-western Pacific, the annual report said that the soundings obtained during the past few years on the course of their voyages to and from Australia, have very largely added to our knowledge of the conformation of the bottom, and valuable information has been collected for submarine telegraph cables, if required.

THE PRINCIPAL SURVEYS OF 1897

HOME

Moore	*Research*	England, south coast	Poole Harbour, Dungeness
		Scotland, east coast	Firth of Forth
Pirie	*Triton*	England, east coast	The Medway, Edinburgh Channel (Thames estuary), Middle Sand, Yorkshire coast
Maxwell	*Gladiator*, h.v.	Ireland, east coast	Carlingford Lough
		England, south coast	Scilly Isles
Haslewood	*Mascotte*, h.v.	England, south coast	Portsmouth Harbour

FOREIGN

Tooker	*Gulnare*, h.v.	Newfoundland	Daniel's Cove, White Bay
Smyth	*Egeria*	Atlantic	Equatorial-current
		South America	Boca Chica, Chilean ports
Gedge	*Stork*	Indian Ocean	Seychelles Islands, Grand Port (Mauritius)
G. E. Richards	*Rambler*	West Indies	Port Royal (Jamaica), Belize
		Newfoundland	Strait of Belle Isle
Field	*Penguin*	Pacific	Deep-sea sounding—Fiji to Honolulu via Palmyra and Fanning Islands
Combe, Pudsey Dawson	*Waterwitch*	Australia, west coast	Esperance Bay
		Australia, west coast	Queensland inner route northward of Cooktown
Howard	*Dart*	Tasmania	Wedge Bay to Port Arthur
		Australia, east coast	Queensland inner route

BY THE MARINE SURVEY OF INDIA

Oldham, Heming	*Investigator*	Indian Ocean	Gulf of Martaban, Andaman Islands

Research, *Triton* and *Gladiator* were at Spithead for the review in June. *Research* found little change at Dungeness Point. In July Dr Fowler was embarked at the instance of the Royal Society for satisfactory trials of his apparatus (see 1896) and an examination of an area north of Sule Skerry.

Triton resurveyed the Duke of Edinburgh Channel and, with the Shingles Patch increasing very slowly, the comment was that the danger of the channel's closing appeared to be less. The Middle Cross Sand had so changed as to alter the whole aspect of the charts, Trinity House having drawn attention to it.

Egeria was commissioned at Sheerness in January by Smyth for service on the coast of British Columbia. In the Atlantic observations were made with the Pillsbury current-meter (see p. 140) to investigate the Equatorial-current. A beacon was successfully moored in 2 958 fathoms in 3° S, 27° W to hold the ship's position; and the results showed a surface current of 0·8 knot with still water below ten fathoms. This was thought startling and to need confirmation, the meter being suspect. Besides other running surveys, work in the Boca Chica confirmed Hall Rock and disproved Cockatrice and Meteor Rocks. Surveys included Coronel Bay, Totoralillo Bay, Huasco, Chañaral de las Animas and Iquique; and Ferrol and Coisco Bays. Deep soundings were taken showing that the deep depression forty miles off the coast between Huasco and Chañaral was a narrow trough parallel to the coast and the Andes.

Stork did searches in the Massawa Channel and for Gannet Bank when on passage to Aden. She also took deep-sea soundings on passage.

Rambler found a new reef eastward of Serranilla Bank.

Penguin did an enormous amount of sounding on a most successful cruise. Field's report showed Fanning Island preferable to Palmyra Island as a telegraph-cable station.

Dart had another casualty when Howard became seriously ill, not long after Parry in September had to go to Sydney for medical treatment.

In India Oldham relinquished command in May, Heming arriving in July.

THE PRINCIPAL SURVEYS OF 1898

HOME

Moore	*Research*	SCOTLAND, EAST COAST	Firth of Forth, Cromarty and Inverness Firths
Combe	*Triton*	ENGLAND, EAST COAST	The Medway, Thames estuary, Edinburgh Channel, Yorkshire coast, Holy Island
Maxwell	*Gladiator*, h.v.	IRELAND, SOUTH COAST ENGLAND, SOUTH COAST SCOTLAND, WEST COAST	The river Barrow Scilly Isles Loch Ryan
Haslewood	*Mascotte*, h.v.	ENGLAND, SOUTH COAST	Plymouth and Portsmouth Harbours

FOREIGN

Tooker	*Gulnare*, h.v.	NEWFOUNDLAND	West coast and Belle Isle Strait
Purey-Cust	*Rambler*	WEST INDIES NEWFOUNDLAND AFRICA, WEST COAST	Trinidad Belle Isle Strait Sierra Leone River mouth
Smyth	*Egeria*	BRITISH COLUMBIA	Johnstone Strait, Baynes Sound, Nanaimo Harbour
Gedge	*Stork*	RED SEA MEDITERRANEAN	Bab-el-Mandeb currents, Massawa shoals Alexandria Harbour
Field	*Penguin*	TASMANIA AUSTRALIA, EAST COAST SOUTH PACIFIC	The river Derwent Sydney Harbour Tonga group
Pudsey Dawson	*Waterwitch*	CHINA COAST	Weihaiwei, Tinghai
Parry	*Dart*	AUSTRALIA, EAST COAST	Queensland inner route

BY THE MARINE SURVEY OF INDIA

Heming	*Investigator*	BAY OF BENGAL	Gulf of Martaban, Moulmein River

Triton found changes in various Thames estuary channels. Shingles Patch had 15 feet over it and its steady growth since 1882 had reduced the width of the channel from a mile and a half to half a mile. 'The total obliteration of the passage, by no means impossible, would entail a long circuit at low water but operations of nature are far too great to be controlled by works.'

Gladiator was concerned with two measured miles for H.M. ships of deep draught at Chesil Beach and Polperro.

Gulnare found no sign of a shoal reported by two ships off Cape Race and it was concluded that they had seen one of the remarkable clusters of jelly-fish which frequent these waters in summer.

Rambler was assisted by *Gulnare* in Belle Isle Strait, and despite bad weather the survey was finished; and, as there were marked differences in depth, the survey would greatly help vessels in fog.

Egeria began by examining the dangerous Ripple Shoal in Johnstone Strait. The difference of longitude of Esquimalt and Vancouver from McGill Observatory, Montreal, was determined with cordial cooperation from the observatory and Canadian Pacific Railway telegraphs. Extensive magnetic and tidal measurements were made.

Stork took extensive current observations in the Strait of Bab-el-Mandeb, finding a surface current into the Red Sea and one outwards at a depth of 100 fathoms both regular at about 1½ knots. The tidal stream flowed for about 12 hours each way at 1¼ knots maximum.

Penguin took more deep-sea soundings and recorded a temperature of 34·5° F at 4762 fathoms in the depression south-east of the Tonga group. The disappearance of Falcon Island was verified.

Waterwitch's survey of Weihaiwei reflected the naval interest in the harbour.

Dart embarked Mr Cowley of Cairns botanical nursery to plant coconuts by request of the Governor of Queensland on off-lying islands in the inner route to aid navigation and possibly to provide subsistence for shipwrecked crews.

THE PRINCIPAL SURVEYS OF 1899

HOME

Moore	*Research*	Scotland, east coast	Inverness Firth
		Scotland, west coast	Loch Broom, Loch Ewe, Portree Harbour
G. E. Richards	*Triton*	England, east coast	The Humber, river Orwell, Harwich
Maxwell	*Gladiator*, h.v.	Scotland, west coast	Loch Ryan
		England, west coast	Morecambe Bay
		England, south coast	Scilly Isles
		Channel Islands	St Peter Port (Guernsey), St Helier (Jersey)
Haslewood	*Mascotte*, h.v.	England, south coast	Plymouth and Dartmouth Harbours

FOREIGN

Tooker	*Gulnare*, h.v.	Newfoundland,	Partridge Point to Fouché Harbour
Purey-Cust	*Rambler*	Africa, west coast	Sierra Leone, rivers Niger and Congo
Smyth	*Egeria*	British Columbia	Discovery Passage
		Pacific	Sounding cruise to Honolulu
Gedge	*Stork*	Red Sea	Kamaran Bay, Massawa shoals
		Mediterranean	Nauplia Bay (Greece)
Combe	*Penguin*	Australia, north coast	Mary Ann Passage, Onslow Harbour
		Australia, south coast	Off Cape Leeuwin
Pudsey Dawson	*Waterwitch*	China coast	Tinghai, Samsa
Parry	*Dart*	Tasmania	Port Davey
		Australia, east coast	Cairns, Queensland inner route

BY THE MARINE SURVEY OF INDIA

Heming	*Investigator*	India, west coast	Honavar to Mangalore
		Bay of Bengal	Andaman Islands

Research also reported on Benbecula as a port of call for local steamers.

Triton found that the decreased depths in the Humber since 1894 were somewhat serious.

Gladiator obtained current measurements on Les Minquiers.

Rambler at Luanda had 40 per cent of her ship's company down with fever in May, probably owing to an unusually wet season, and was sent to Ascension for a month's change of climate. Important observations were made of the undercurrents at the mouth of the Congo, which were published by the Admiralty.

Egeria's deep-sea cruise to Honolulu and on to 9° N, 157° W was to complete soundings on the whole route for a telegraph cable from Vancouver to Australia. Taken every 20 miles there were 166 soundings with an average depth of 2 420 fathoms. A report was prepared by Somerville. Learmonth was invalided in May.

Stork surveyed Kamaran quarantine station at the request of the Turkish Government and was accompanied by a Turkish naval officer. Yet another search was made for Akbar Rock in Massawa approaches but even after a long and tedious operation it was impossible to say in such coral-studded waters that no danger existed. The ship arrived home in December, and finally paid off at Chatham after eleven years' surveying abroad.

Penguin's work on the north-west Australian coast had long been desired by the Western Australian Government. Cape Leeuwin was a landfall for all mail steamers bound for Australia.

Waterwitch suffered from a typhoon which wrecked a loaned steam pinnace. It was looted by the Chinese but repaired at Foochow arsenal.

Dart planted more coconuts on Flinders Island, and those planted on Morris Island the previous year were flourishing.

THE PRINCIPAL SURVEYS OF 1900

HOME

Moore, Field	*Research*	Ireland, west coast	The Shannon, Bantry Bay, Kinsale Harbour
		England, south coast	Fowey Harbour
G. E. Richards	*Triton*	England, east coast	The Orwell and the Stour, Harwich, Thames estuary, Dover Harbour, river Humber
Maxwell	*Gladiator*, h.v.	Ireland, west coast	Blacksod Bay, Achill Sound
Haslewood	*Mascotte*, h.v.	England, south coast	Plymouth, Portsmouth and Dartmouth Harbours

FOREIGN

Tooker	*Gulnare*, h.v.	Newfoundland	Canada Bay, Notre Dame Bay
Purey-Cust	*Rambler*	Africa, south coast	Cape Peninsula
		Africa, east coast	Durban, Pungue River, Beira, Zanzibar
		Arabian coast	Perim to Ras Kaau
		Red Sea	Port Ibrahim (Suez)
Smyth, Simpson	*Egeria*	British Columbia	Discovery Passage, Johnstone Strait
Combe	*Penguin*	Australia, north coast	Ashburton Road to North-west Cape, Barrow and Monte Bello Islands, Recherche Archipelago
Pudsey Dawson, Lyne	*Waterwitch*	China coast	The Yangtze, Shaweishan to Drinkwater Light, Hong Kong to Canton River
Parry, Monro	*Dart*	Australia, east coast	Princess Charlotte Bay, Flinders group to Cape Melville

BY THE MARINE SURVEY OF INDIA

Heming	*Investigator*	India, east coast	Honavar to Mangalore

At home a party under Gedge resurveyed the Tyne.

Research embarked Dr Fowler to carry out zoological investigations in deep water south-west of Ushant. Here the ship narrowly escaped annihilation by a Greek steamer, which was bearing down on her, apparently to see what she was doing. Field had assumed command in April.

Triton lost a valuable officer, Lieutenant Waugh, from the effects of fetid exhalations of the mud below Ipswich in the Orwell. Some silting was found at Dover but it was confidently expected that it would cease as Admiralty Pier was extended.

Gulnare disproved the existence of a rock charted for 140 years to the westward of Belle Isle Strait.

Rambler's survey of Beira was of importance for the trade to Rhodesia, the navigability of its entrance having been discovered in 1885.

Rambler found a bank in the Strait of Georgia with the submarine sentry, which was introduced in 1898.

Penguin, after rendering assistance to a vessel stranded on the Flinders group, examined two areas off the Gulf of Carpentaria. Proceeding westwards she examined Money Shoal, Marie Shoal off Melville Island, two reefs south-east of Cartier Island, first reported by Heywood in 1801, and Browse Island. There were other searches which disproved reported shoals. Many new dangers were found between Cape Le Grand and Pollock Reef when surveying the route to Esperance Bay from the eastward.

Waterwitch was temporarily in charge of the Shanghai division, when in June the Senior Officer left for Nanking during the Boxer outbreak, and was detained for some weeks in case her men were needed for the defence of the town. Her work in the north channel of the Yangtze was assisted by Mr Tyler of Chinese Customs and the manufacture of floating beacons by H.M. ships. H.M.S. *Centurion* used the channel safely a week after Lyne's report to the Commander-in-Chief. Lyne had succeeded Pudsey Dawson in April.

Dart found Wikengen Reef, already searched for unsuccessfully on two previous occasions. Again she had a case of serious illness, Lieutenant Stainer being landed at Townsville to intercept a steamer from China bound for Sydney.

THE PRINCIPAL SURVEYS OF 1901

HOME

Field	*Research*	ENGLAND, SOUTH COAST	Portsmouth Bar, Dover Strait currents
		SCOTLAND, WEST COAST	Loch Alsh, the Narrows of Raasay
G. E. Richards	*Triton*	ENGLAND, EAST COAST	The Stour, Harwich, Whitby to Scarborough, Thames estuary, Edinburgh Channel
Maxwell	*Gladiator*, h.v.	ENGLAND, WEST COAST	Barrow-in-Furness, King Road (Bristol Channel)
		CHANNEL ISLANDS	St Helier, St Catherine's Bay
Haslewood	*Mascotte*, h.v.	ENGLAND, SOUTH COAST	Plymouth and Portsmouth Harbours

FOREIGN

Tooker	*Gulnare*, h.v.	NEWFOUNDLAND	Badger Bay
		CANADA, EAST COAST	Cape Breton, Sydney Harbour (Nova Scotia)
Smyth	*Rambler*	RED SEA	Bab-el-Mandeb to Mocha
		CHINA COAST	East Lamma Channel, Hong Kong
Simpson	*Egeria*	BRITISH COLUMBIA	Johnstone and Broughton Straits
Combe	*Penguin*	AUSTRALIA, SOUTH COAST	Recherche Archipelago
		NEW ZEALAND	Bay of Plenty, Aukland approaches, Gisborne Harbour
Lyne	*Waterwitch*	CHINA COAST	Hong Kong approach, Yellow Sea, Socotra Rock, the Yangtze, Weihaiwei, Shitan Bay, Shantung
		BORNEO	North-west coast
Monro	*Dart*	AUSTRALIA, EAST COAST	Queensland inner route, Melville Pass

BY THE MARINE SURVEY OF INDIA

Heming	*Investigator*	INDIA, EAST COAST	Cuddalore to Point Calimere
		BENGAL	Chittagong River

Tidal streams were observed in the Channel Islands, Pasco being embarked in H.M. Ships *Raven* and *Seahorse* successively.

Research measured undercurrents off Dover, establishing that the current extends from the surface to the bottom on both sides of the strait.

Triton found important shoaling off North Foreland and a steady increase of the Shingles Patch.

Rambler was recommissioned by Smyth in March. Her survey in the Red Sea was important and successful despite the heat, on account of which fourteen men, including Lieutenant Buckle, were invalided.

In contrast, men of the *Egeria* had to traverse deep snow to reach main stations in British Columbia.

Penguin made an excellent beginning in New Zealand where the Government had requested a resurvey and met a moiety of the expenses.

Waterwitch in North Borneo was first engaged with Dutch officers in marking the boundary between the territories. Back in Chinese waters, she found 18 feet on the danger reported by the P & O mail steamer *Socotra* in 1900. The annual report commented that the reef was small, and 80 miles from the nearest coast in the centre of the approach to the Yellow Sea. It stood in 23 fathoms with strong ripples round it, but probably owing to its insignificant size and the many tide-rips in the vicinity it had long escaped discovery.

Dart continued to be dogged by casualties. Two officers died of pneumonia in June and in September a man with tetanus had to be landed.

THE PRINCIPAL SURVEYS OF 1902

HOME

Field	*Research*	Scotland, west coast	East and West Loch Roag
Purey-Cust	*Triton*	England, south coast	Dover Bay
		England, east coast	Thames estuary, Edinburgh Channel
		Scotland, east coast	Moray Firth to Burgh Head
Maxwell	*Gladiator*, h.v.	Ireland, south coast	Queenstown Harbour
		England, west coast	Bristol Channel King Road
Haslewood	*Endeavour*, h.v.	England, south coast	Plymouth and Portsmouth Harbours, Wembury Bay

FOREIGN

Tooker	*Gulnare*, h.v.	Newfoundland	Bay of Exploits
Simpson	*Egeria*	British Columbia	Broughton Strait, Queen Charlotte Sound, Bull and Beaver Harbours, Haro Strait
Learmonth	*Goldfinch*	Mediterranean	Gibraltar, Gulf of Kolokithia
		Africa, west coast	The Niger entrances
Smyth	*Rambler*	China coast	Pei-ho, Taku Bar, Shantung Promontory to west coast of Korea
Hardy	*Waterwitch*	China coast	Weihaiwei approach, Mirs Bay
Combe, Pudsey Dawson	*Penguin*	New Zealand	Tolago Bay to Young Nick's Head, Gisborne, Bay of Plenty
Pasco	*Dart*	South Pacific	Solomon Islands, Tulagi and Isabel Islands

BY THE MARINE SURVEY OF INDIA

Heming	*Investigator*	Bay of Bengal	Chittagong, Tenasserim coast

The home ships assembled for the Coronation Review in June. Owing to the King's illness it was postponed and only *Gladiator* was concerned with marking berths for the Fleet in August.

Research also fixed the measured-mile beacons at Chesil Beach and examined Prince Consort Shoal at Cowes, a shoal continually on the move.

In *Triton* Purey-Cust succeeded Richards in March. The Shingles Patch had shoaled, but a long ridge of sand forming between Knock John and Long Sand seemed to favour the maintenance of depth in the northern part of Edinburgh Channel by diverting more water down it. Dumping of Thames spoil had had little effect on Barrow Deep.

Egeria had nearly completed the narrow part of the channel separating Vancouver Island, from the mainland and found many rocks, twelve in this year.

Goldfinch had been adapted for surveying and was commissioned at Sheerness in February by Learmonth. The eastern side of Gibraltar was sounded to determine the feasibility of a harbour and, as mentioned on p. 132, Tizard was sent from the department to report. On passage to the Niger, deep-sea soundings were obtained.

Rambler's survey of Taku was at the request of an international commission which gave assistance. The soft mud of the bar meant special equipment to obtain depths. In the autumn, fair charts were drawn at Yokohama.

In *Waterwitch* Hardy relieved Lyne in March. Two lieutenants, Constable and Warburg, were invalided home.

Penguin had made a good start on New Zealand coasts when Pudsey Dawson succeeded Combe in August. A great many years' work were foreseen if a ship could be spared.

Dart was transferred to the Solomon Islands since the Queensland Government intimated that they wished to discontinue work on their coast. She grounded without damage in Thousand Ships Bay on the coast of Isabel. The natives were quiet and peaceable contrary to expectation.

THE PRINCIPAL SURVEYS OF 1903

HOME

Field	*Research*	England, west coast Scotland, west coast Hebrides	Padstow Loch Eriboll, Gare Loch Stornoway
Purey-Cust	*Triton*	North Sea Scotland, east coast	Tidal observations and banks Burghead to Buckie
Maxwell	*Gladiator*, h.v.	Ireland, west and south coasts	Queenstown, Ballydivlin Bay, Valentia and Youghal Harbours
Haslewood	*Endeavour*, h.v.	England, south coast	Plymouth, Portsmouth, Teignmouth, Portland and Looe Harbours

FOREIGN

Tooker	*Ellinor*	Newfoundland	Bay of Exploits
Learmonth	*Goldfinch*	Africa, west coast Newfoundland	The Niger delta Belle Isle Strait
Parry	*Egeria*	British Columbia	Juan de Fuca Strait, Queen Charlotte Sound, Nanoose Bay
Smyth	*Rambler*	China coast	Shaweishan Bank off the Yangtze, Hong Kong approach, Amoy
Hardy	*Waterwitch*	China coast	Shantung Promontory, Mirs Bay
Pudsey Dawson	*Penguin*	New Zealand	Bay of Plenty, Port Nicholson, east coast of North Island
Pasco	*Dart*	Australia, north coast	Torres Strait approach

BY THE MARINE SURVEY OF INDIA

Heming	*Investigator*	Bay of Bengal	Arakan and Tenasserim coasts, Andaman Islands

Research further examined the magnetic anomaly found the previous year at the entrance to East Loch Roag. The compass of a deep-sea current-meter unfortunately failed to work. A mile south of Dodman Point two shoal patches were found with the help of the coastguard and a fisherman.

Triton checked soundings at Dover where harbour works were in progress. She used a new pneumatic tide-gauge on Brown Ridge, Swarte Bank and Dogger Bank. Very fairly marked tidal curves were obtained and an observation made by Hewett in 1840 was verified. East Dudgeon Shoal and Triton Knoll had increased.

Gladiator triangulated Polperro measured-mile beacons.

Ellinor was an auxiliary yacht chartered in England with better sea-keeping qualities than *Gulnare*. She worked with *Goldfinch* in the eastern approaches to Belle Isle Strait.

In *Goldfinch* Learmonth took great precautions successfully to save his crew from fever on the Calabar coast. Before crossing the Atlantic in May, the ship took observations in the Guinea-current showing it to be a comparatively shallow body of water. She also, on passage from and to Africa, successfully disproved a shoal off the Bissagos Islands. The reporting ship *Ruapehu* must have been 15 miles nearer the shore.

Rambler had to overcome bad weather and strong rotary streams on Shaweishan Bank as well as hindrance from junks with drift-nets. The survey was dependent on astronomical observations and beacons.

Waterwitch met a severe gale in Formosa Channel and lost three men overboard.

Penguin searched a large area in the Pacific 400 miles north-east of New Zealand and found a ridge with 110 fathoms giving rise to tide-rips. However, the *Star of Bengal* had reported seeing bottom and, however unlikely, that a further search would have to be made.

Dart's officers before leaving Hobart, surveyed Hunter Passage. Being found insufficiently seaworthy to continue surveys in the Solomon Islands after her 18 years' service, she was employed again on the inner route to Torres Strait for one more season.

3

Admiral Sir A. M. Field, K.C.B., F.R.S.

HYDROGRAPHER 1904–1909

AFLOAT

W. F. Maxwell, Tooker, Smyth, Haslewood, Heming

ASHORE

Clark

ARTHUR MOSTYN FIELD was born in 1855, the younger son of Captain John Bousquet Field, R.N. He entered the Royal Navy as a cadet in 1868, becoming a midshipman in 1870 and a sub-lieutenant in 1874. Like his predecessor, Wharton, he was awarded the Beaufort Testimonial for the best examination in navigation and pilotage for the rank of lieutenant, coupling with it the distinction of obtaining full marks.

Field served for a few months as a lieutenant in H.M.S. *Black Prince*, flagship of the Channel Squadron, before he began his surveying career in 1876, when he joined the *Fawn*, Wharton, and served in her for four years on the east coast of Africa, in the Mediterranean, and in the Red Sea. In 1881, when only twenty-six, he was sent on detached duty to survey the entrances to various rivers in the Niger delta. In 1882 he joined the *Sylvia*, Wharton, on the east coast of South America and in Magellan Strait, staying in her when she was transferred, then under Aldrich, to a survey on the east coast of South Africa.

In January 1885, Field obtained his first command, in the *Dart*, operating under the orders of the Commander-in-Chief, off the east coast of New Guinea, during which period he proclaimed the Trobriand Islands a British protectorate. In 1886 he was commended by Their Lordships for his surveying work. In 1887–88 he carried out surveys in Tasmania and the Louisiade Archipelago, returning to England in 1889 and being promoted to commander. In 1890 he took command of the *Egeria*, and spent four years in the China Seas, off Borneo, and in the eastern approaches to Singapore before bringing the ship home to pay off in mid-1894, executing surveys in the Red Sea while on passage. His work again received Their Lordships' approbation in 1893.

In 1895 Field was promoted to captain, and the next year resumed his sea service in command of the *Penguin*. For three years he was employed on exploratory surveys in the Pacific, including the Tonga, or Friendly, Islands, and also the well-known survey and borings at the Funafuti Atoll under the auspices of the Royal Society in 1897. This ended his foreign service, which had been almost continuous for twenty-three years; and there followed four years in the *Research*, surveying in Irish and Scottish waters. During 1903, in company with H.M.S. *Flirt*, experiments were made near the Channel Islands for sounding at speed using the Thomson machine but without chemical tubes; and, for a time, the resulting speed and depth tables bore Field's name. Field left the *Research* and joined the department in April 1904, prior to succeeding Wharton as Hydrographer on 1 August.

During his period as Hydrographer, Field was much concerned with the status of Chart Branch staff, and successfully contended that the work of the draughtsmen made a new title of cartographer more apposite. Afloat, he introduced a new non-substantive rating of surveying recorder with an allowance. He was elected a Fellow of the Royal Society in 1905 and was made a rear-admiral in 1906; and in 1909, after the Port of London Act of 1908, he was appointed the first Admiralty representative on the Port of London Authority, where he served until 1925.

On 15 August 1909, Field completed his five-year tenure of office, and was succeeded as Hydrographer by Purey-Cust. The next year, he was made a vice-admiral on the Retired List; promotion to admiral followed in 1913, and he was made a K.C.B. in 1911. He was the Acting Conservator of the river Mersey[1] from 1910 to 1930 and was a nautical assessor to the House of Lords. He revised and enlarged Wharton's *Hydrographical Surveying* for its third and fourth editions of 1909 and 1920, with the result that it was known familiarly as ' Wharton and Field ' for many years. He collaborated with Purey-Cust in taking out a provisional Admiralty patent in 1908 for the Field/Cust automatic tide-recorder.

In private life he took a great interest in the problems concerning science and religious dogma. He died on 3 July 1950, six days after his ninety-fifth birthday.

The contemporary scene

Field's tenure of office saw the Edwardian scene subsequent to the Russo-Japanese war of 1904–5 become increasingly clouded over by the challenge of German diplomacy. On the grounds of encirclement by the Franco-

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[1] His predecessors had been Fitzroy, 1842–43, G. Evans, 1843–77, Spratt, 1879–88, G. Richards, 1888–96, and Nares, 1896–1910.

Russian alliance of 1893 and the Anglo-French *entente* of 1904, as well as of a lack of a ' proper place in the sun ' compared with other colonial Powers, Germany increased her army and challenged Britain's naval supremacy. In 1905 she objected to French expansion in Morocco, and at the subsequent Algeciras conference Britain showed sympathy with France. In 1907 there was the Anglo-Russian convention, which recorded a settlement of differences over Persia. A Franco-British exhibition of 1908 had some political importance, the department sending a number of items.

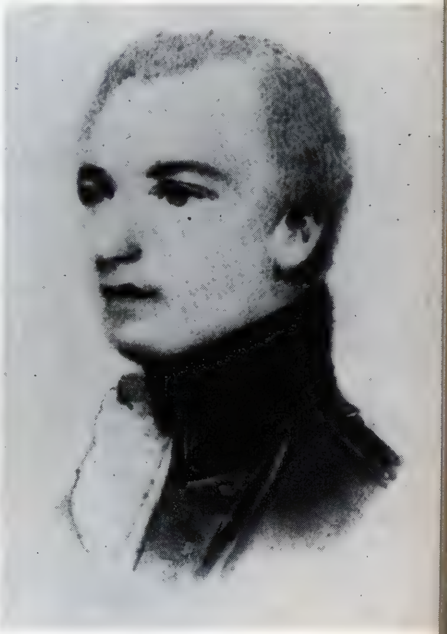
In the Balkans, where the conflicting interests of the Great Powers had been resolved some thirty years earlier, the year 1908 saw the annexation by Austria-Hungary of Bosnia-Herzegovina, followed by her threat to Serbia. Turkey was affronted; and Russia, with her traditional concern for the use of the Dardanelles and a warm-water port, fell out with Austria-Hungary to the verge of war. Germany, however, disregarding Britain's diplomatic efforts, decided to avoid isolation and to support Austria-Hungary at some expense to her friendship with Turkey and her Berlin-to-Baghdad project. Her military strength proved too great for Russia, and an uneasy peace ensued.

At the Admiralty, Fisher was First Sea Lord. In 1905 a redistribution of the Fleet took place, which concentrated it into the Channel, Home, Atlantic, and Mediterranean Fleets, based on Portsmouth, the Nore, Gibraltar, and Malta. In 1906 there were the Grand Manoeuvres in home waters, and in that same year, the *Dreadnought*, a battleship of much-increased power, was launched, which, incidentally, prompted Germany to enlarge the Kiel Canal to take similar vessels. In the 1909 Estimates, McKenna, then First Lord, proposed six ' Dreadnoughts '. The Cabinet agreed to four at first but, under pressure of public opinion, expressed in the music-hall ditty, ' We want eight and we won't wait ', eight were laid down and five were to follow in each of the two succeeding years. Submarines made their debut, there having been trials of the first British boat in 1902. Mine warfare had already been used in the Russo-Japanese war.

The department was heavily involved in defence measures. In January 1906 the Hydrographer reported that the war organization of chart establishments was complete. Issues Branch was increasingly committed and, for example, instituted home destroyer chart sets, there being fifty-four destroyers and ten torpedo-gunboats involved in the Grand Manoeuvres. There was a first requirement for a greatly enlarged chart of European waters to meet the operational need of the Commander-in-Chief; and the Director of Naval Intelligence needed a chart of the world, which was done on corticene by Malby in 1908. For operational use, ten sets of German charts of their coasts were made by photozincography, being of larger scale than the Admiralty charts that sufficed for navigational purposes. Remarking in February 1908 on a paper discussing a possible German invasion, the Hydrographer showed the ports from which an armada might issue, and where it could assemble.

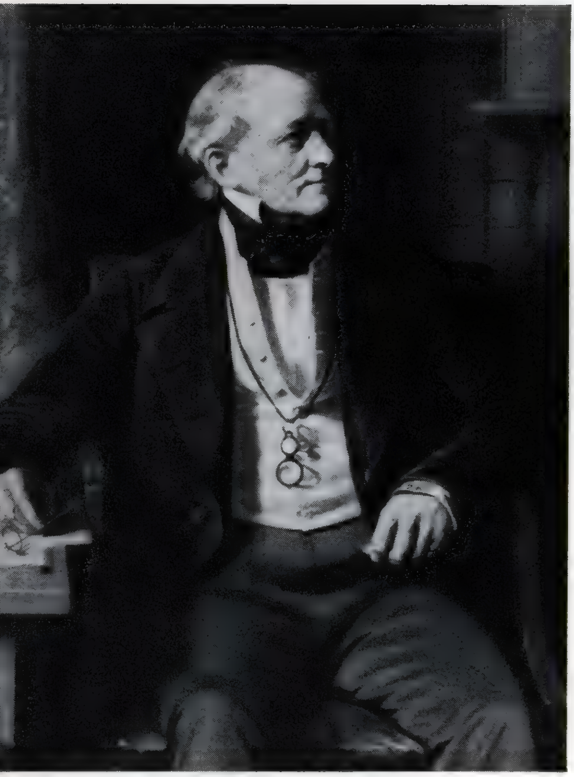
Hydrographers of the Period

19. Alexander Dalrymple, F.R.S.
Hydrographer: 1795 to 1808



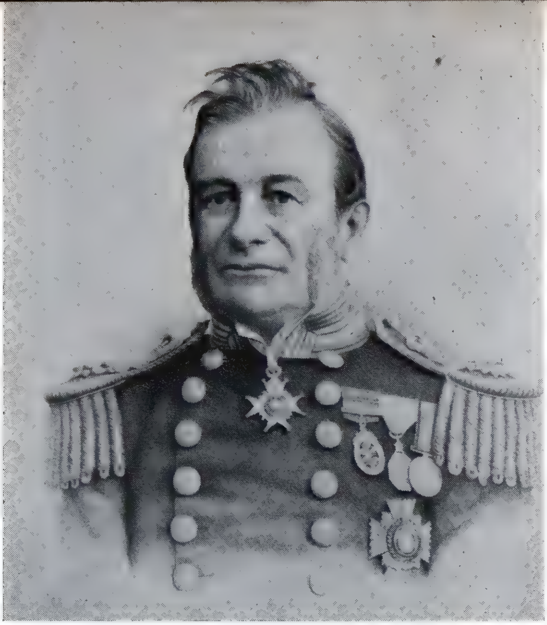
20. Captain Thomas Hurd, R.N.
Hydrographer: 1808 to 1823

21. Rear-Admiral Sir W. Edward Parry, LL.D., F.R.S.
Hydrographer: 1823 to 1829

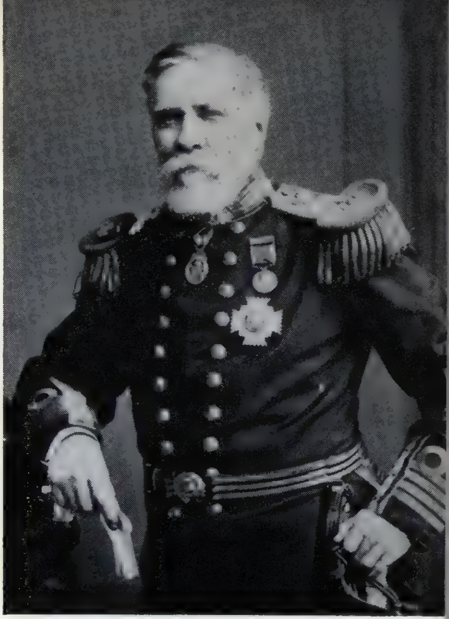


22. Rear-Admiral Sir Francis Beaufort, K.C.B., D.C.L., F.R.S.
Hydrographer: 1829 to 1855

23. Rear-Admiral John Washington, F.R.S.
Hydrographer: 1855 to 1863

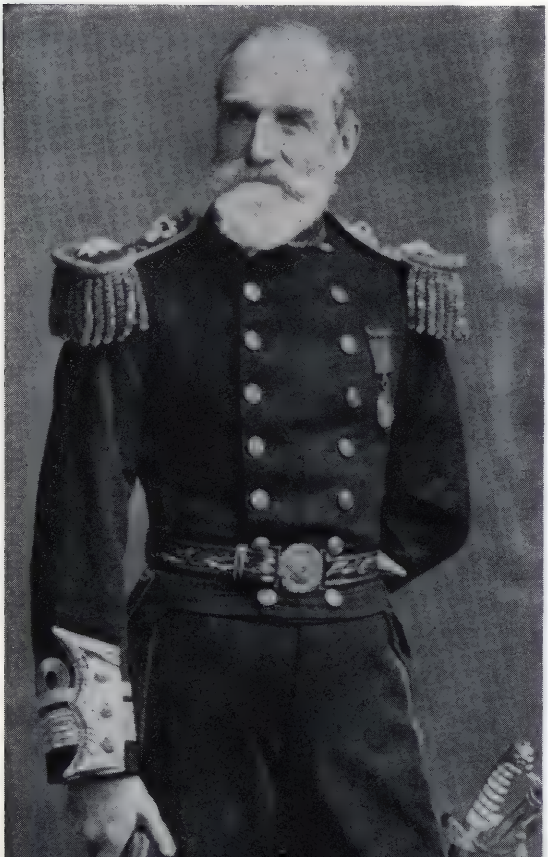


24. Vice-Admiral Sir George H. Richards, C.B., F.R.S.
Hydrographer: 1864 to 1874



25. Captain Sir Frederick J. O. Evans, K.C.B., F.R.S., R.N.
Hydrographer: 1874 to 1884

26. Rear-Admiral Sir William J. L. Wharton, K.C.B., F.R.S.
Hydrographer: 1884 to 1904



27. Rear-Admiral Sir A. Mostyn Field, K.C.B., F.R.S.
Hydrographer: 1904 to 1909

28. Admiral Sir H. E. Purey-Cust, K.B.E., C.B.
Hydrographer: 1909 to 1914

29. Rear-Admiral Sir J. F. Parry, K.C.B.
Hydrographer: 1914 to 1919

The Fleet's requirement for gun-calibrating ranges meant the siting and triangulation of beacons and the supply of dry proofs, free from distortion, of large-scale charts of many fleet anchorages at home and abroad. In 1908, duplicate copper plates took the place of the dry proofs, and by the end of the year a more accurate method involving theodolite observations at two triangulated sites was adopted. Harbour defences, examination services, torpedo-ranges, and so on, at home and abroad, continued to be the subject of many files in the Confidential minute-books, including the details to be promulgated or inserted on charts. Resurveys of anchorages were required, the Hydrographer reporting on the progress with those of west Scottish lochs; and from 1906 there were surveys in the Orkneys, including Scapa Flow. Advice was given on battle-practice areas; and in the winter of 1907, officers of the *Triton* and the *Research* were lent to the Fleet for rangefinder experiments.

The Admiralty harbour at Dover was in its final stages of construction, and the Hydrographer was constantly consulted by the Director of Works and others. There was a mooring plan for eight battleships and in 1907, one, accompanied by a cruiser, was sent to test the width of the entrances; and a year later the battleship *Jupiter* was sent to try out the moorings in southerly gales. In 1906 there was a new Admiralty agreement with the Dover Harbour Board, and the recurring problem of maintaining dredged depths in the harbour was illustrated in 1907 by Admiralty objection to the proposed construction of docks at the root, and on the west side, of the Prince of Wales Pier.

The Hydrographer was also consulted about the Rosyth naval base, though expenditure on it was reduced in 1906; and in 1909 he recommended that it should be declared a dockyard port by Order in Council. He commented in 1905 on the comparative advantages of Darwin and Singapore as a Fleet base.

The period saw, in 1909, Blériot's flight across the Channel, the first aeroplane having been flown by the Wright brothers in America six years earlier. In London in 1905, motor omnibuses replaced the horse-drawn, and underground railways began to run.

Polar exploration continued. In 1907 Shackleton, in the *Nimrod*, of the British Antarctic Expedition was lent instruments in anticipation of the receipt of hydrographic information. Field sounded a warning-note to the Board lest it commit the Admiralty to any relief expedition; and a year later on a Treasury inquiry, he advised that the expedition was backed by wealthy persons well able to afford relief arrangements if forced by public opinion. The expedition got within 100 miles of the South Pole, reached the magnetic pole and there took possession of Victoria Land and the polar plateau for King Edward VII. There was activity in the Antarctic by South American and Scandinavian countries also. The North Pole was reached by an American, Peary, in 1909. Bruce was lent instruments for a Scottish oceanographic expedition to Spitsbergen, as he had been for his Antarctic expedition of 1902–4 when losses were waived in consideration of the value of the hydrographic information obtained.

A special report to the First Sea Lord

Within three months of assuming office, Field had verbal direction from the First Sea Lord to report on ' the Hydrographical Service of the Admiralty with the possible changes and economies which might be effected '; and a lengthy and interesting report dated 25 November 1904 is in Confidential Minute-book 2, p. 165a. It contained some background history and formed the conclusion that:

> The intimate connection that has always existed between the Hydrographic Service and the general service of the Navy from the very first is the strongest and best part of our system; its success has abundantly proved the foresight of the great men in the latter part of the eighteenth century, who devised the system and carried it into effect; it is the envy of foreign Hydrographers, who bewail that they have not the same system to rely upon. The advantage to the Fleet at large, by enabling it to draw a leavening of surveying officers as navigators, has just been dealt with by me in a separate paper. . . . As regards the men, so long as they are under naval discipline it would not much signify, perhaps, if they were non-continuous service men and shipped exclusively for service in surveying ships, if it is considered inadvisable to withdraw men from the Fleet for that purpose, but it would be far more expensive to the nation.

On the conduct of modern surveys, there were references to the greater detail required and the greater expenditure of time, as well as the impossibility of saying what part of the world might next be the scene of operations. Not for two or three generations would charts of the world be in sufficient detail, but this was no reason to relax effort. Iron bottoms were so easily penetrable by rocks, and the loss of a battleship would be financially comparable to the cost of the surveying service for ten years. There were no other surveying ships in the whole Empire except for one under the Indian Government and one on the Canadian lakes.

Field, continuing, stated that surveys were not only for the Navy but also for the benefit of British commerce and, on the assumption that his arguments had shown the need to maintain if not increase the number of surveying ships, he led up to his first submission that the Board of Trade Estimates should include £50 000, the equivalent to half the sum for maintenance, at present wholly borne on the Navy Vote. He realized that this would give the Board of Trade the right to call on the diversion of one ship in home waters and two abroad in pursuance of the safety of merchant shipping; and if they required more ships, their Estimates should be increased accordingly for the purpose. There is no record that this suggestion was discussed further.

The second and third recommendations, which were in fact followed up as shown later, concerned the sale of charts. Field referred to the Admiralty's broadminded policy of keeping prices down, so as, for example, to minimize the danger of ships' purchasing and navigating on small-scale charts only; though it also benefited foreign Governments. He thought an increase of thirty-three per cent in chart prices would not materially affect sales and would increase receipts by £7 000 per annum. An alternative would be to emphasize copyright and to treble prices, but this could lead to piracy since the enforcement of a monopoly would not be practicable. Moreover, it could lead to the Navy's freedom from light and harbour dues being challenged by merchant-shipping interests. Finally, ' it might be considered bad policy to put additional charges on the industry whereby the population of these islands is maintained, for it is upon our shipping we depend both in peacetime and wartime '.

In parallel with a thirty-three per cent increase in chart prices, the agent's discount on sales could be reduced from forty to thirty per cent, and, reverting to the proposed Board of Trade contribution to surveys, the sums so realized would more than cover an expansion of departmental staff to handle the increase in incoming survey data. There had earlier in the introductory remarks been a comparison with the Ordnance Survey costs, showing that in 1903 they were £279 163, whereas those of the Hydrographic Department were £116 511.

Departmental activity

The only change in the Hydrographer's responsibilities, shown in the 1909 revision of his Instructions from the Board, was the transfer of examinations in pilotage to the Navigation School, Portsmouth, from January 1906. The school, newly commissioned as H.M.S. *Dryad*,[1] increasingly advised on, and undertook trials of, new navigational equipment, often at the instigation of the Hydrographer.

An important additional source of information was the report in January 1906 of the 1905 committee on the organization of the department,[2] which stemmed from proposals made by Field in April 1905. This report was particularly concerned with the staff of Chart Branch, and it considered that the addition of six draughtsmen, two of which could be ' hired ' for copying work, was the irreducible minimum with a further increase foreseeable. In May 1907, the Treasury agreed to four ' dockyard ' draughtsmen only, on an experimental basis. In July 1908, Field made a further report, and in January 1909, nearly four years after his original proposals, during which there had been no entries by Civil Service examination to fill even two vacancies, the Treasury at last approved that the draughtsmen should be designated cartographers, that five should be added to the existing fourteen in addition to four ' hired ' in lieu of the four dockyard draughtsmen, and that there should be three chief cartographers, one of first and two of second grade, within the complement.

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[1] See p. 129.

[2] Appendix C, 4.

The 1905 committee, with Rear-Admiral Adair as chairman and Captain H. F. Oliver as one of the members, was set up to consider the introduction of the seven-hour day, the possible delegation of more work to civilians, the duration of naval appointments, and the position of Compass Branch. It took and recorded evidence from Tizard, Assistant Hydrographer since 1891, Stanley, in charge of Chart Branch since 1879, Barber, Chief Civil Assistant since 1904, and some draughtsmen. Much information on the period is consequently provided.

There were appendices on the business daily transacted and on statistics adverting to the 1883 committee, e.g.

	1883	*1904*		*1883*	*1904*
Naval staff	12	13	New charts	61	100
Draughtsmen	6	14	Large corrections	67	180
Secretarial	1	8	Plate corrections	2 700	5 140
Messengers, packers	4	10	Hand corrections to stock	23 200	58 205
Salaries	£9 146	£14 387	Charts catalogued	2 600	3 450
Engraving, etc.	£13 036	£30 869	Printings	229 700	661 590
Contingencies	£880	£1 784	Issues value	£11 500	£33 950
Total expenses	£23 062	£47 040	Sales value	£8 390	£29 091
			Total income	£19 890	£63 041
In documents	—	1 135			
In papers	2 060	4 360	Notices to Mariners	290	1 245

The committee found that the increase of work was primarily due, firstly, to the expansion of the Fleet and of both British and foreign mercantile marines, and, secondly, to the receipt of more information from foreign departments. The latter, according to Stanley, were in particular those of America, Germany, and Japan, the last-named becoming a rival for speed and celerity; he also mentioned Russia and the Chinese Maritime Customs.

Chart Branch, the committee said, was the oldest and most important, by which the credit of the department must rise and fall. It quoted Stanley: 'The cost of maintaining the accuracy of our charts is an infinitesimal insurance on the safety of our Fleet as well as of all ships using our charts.' It saw that the branch's arrears were not inconsistent with its achievements, since material was dealt with under two headings, one part absolutely necessary, the other desirable, being handled by selection according to frequency of use or shifts in the political horizon. It observed that it was bad business to have material at hand and not to use it for the gain of H.M. ships in particular, and of the Exchequer from sales. It showed that financially the cash-and-kind balance had been converted between 1883 and 1904 from a deficit of £3 172 to a surplus of £16 011, with parallel increases in sales receipts. It considered that its proposals for additional staff would be more than balanced by increased profits.

The professional evidence was strongly in favour of highly qualified draughtsmen, and Field, in November 1906, again proposed to stiffen the Civil Service entry examination in non-technical subjects. Barber, on the other hand, mentioned the difficulties of recruitment and advocated, partly on economic grounds, a class of draughtsmen as in the Controller's department, which could, in due course, fill vacancies in the higher grade by selection or limited competition. Outside drawing-work was shown to be uneconomic, unless done by the department's draughtsmen, who, under the agreed seven-hour day, should no longer work in their spare time. It accordingly ceased, and some adjustment of the draughtsmen's salary increments was approved to cover their extra hour of work. Meanwhile, in January 1905, Field had obtained the promotion of Gibson to join Clark as a chief draughtsman, although Briggs was his senior. Gibson had been highly thought of by Wharton, and was to give long and exceptional service as chief cartographer. He received a special salary increment of £10 in 1907.

Underhill took over as Curator, with no change in allowance proposed by the committee, though the work now included Confidential charts and the maintenance of those showing telegraph cables, which were on issue to commanders-in-chief and the War Office. Also in 1905, Mason, from the Accountant-General's department, filled a vacancy as a temporary draughtsman, and was to give distinguished service for many years.

Field in his report of July 1908[1] said that a year's experiment had shown the employment of dockyard draughtsmen to have been disadvantageous. The lack of skilled draughtsmen had meant that the output of new charts had fallen by sixty per cent and, though the seven-hour day was convenient, it had been counterbalanced by the draughtsmen's adoption of the standard midday break, which the committee had considered important. Arrears had grown seriously, and a recourse to the use of Notices to Mariners to deal with increasing foreign information had swollen their number from 1 088 in 1903 to 2 200 in 1908.[2]

Field pointed out that the U.S. Government was reproducing our charts and selling them at a lower price, and furthermore he advised that sales would drop if confidence were reduced in Admiralty charts. He concluded that disaster might befall sooner or later, saying: 'It is with a strong sense of duty therefore that I am impelled to place these considerations before Their Lordships with a view to their speedy rectification since the report of the committee has failed to realize its object.' The Treasury decision in January 1909 has been stated herein, but it was not before (in July 1908) Field, and also a memorial by Gibson, had advanced the case again for senior cartographic posts. Cartographers' salaries were approved at £100 the first year and then £120–20–400; and chief cartographers £415–15–500 for the second grade, and £500–20–600 for the first.

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[1] Minute-book 80, file 55—Appendix C, 2.

[2] See also p. 217.

In 1907 Clark, then sixty, was allowed to complete forty years for pension. He was succeeded as chief draughtsman by Briggs in December 1907, a fifth dockyard draughtsman filling the vacancy. In 1909 Gibson and Briggs were joined by Underhill to make the three chief cartographers, and in this year there were twelve cartographers and four hired draughtsmen. Codd succeeded Underhill as Curator. J. W. Atherton drew up a new table of meridional parts in his spare time, the Treasury agreeing in 1908 to an honorarium within £50 on completion. In the result, £75 was paid in 1910.

The 1905 committee's report on the naval staff and secretariat resulted in no increase in the ten naval assistants, whose distribution of work has been given on p. 124. They had been relieved of the examinations in pilotage, and increasing assistance had been given them by the enlarging secretariat, but there could be no further devolution of duties from naval to civilian staff. The report was insistent that the second-division clerk with Sailing Directions Branch must be full time in order to allow the superintendent (the newly approved title) to relieve the Assistant Hydrographer by taking over the checking of the revisions, which were all being done outside. The salary of the superintendent as a captain (Monro succeeded Langdon in 1909) was made £800, and his former allowance of £50 was transferred to the assistant, who had to be able to translate foreign notices. The latter was handling over 4 000 papers a year, and, in 1907, C. V. Smith was the first to become known as the Jacketing Officer.

The title of Superintendent of Charts was re-established with a salary of £700–800. The senior of the two assistants in Chart Issues Branch was to start at £450 if a lieutenant, the work having much increased with the institution of two-year commissions and the redistribution of the larger Fleet. Otherwise, the salaries of naval assistants at £500–600 for those who had reached commander's rank on the Active List, and £400–550 for lieutenants, needed no increase for the extra hour, since they 'held their appointments during pleasure'.

The Assistant Hydrographer's salary was increased to £950, the committee acknowledging Tizard's immense personal contribution, and singling out his invaluable assistance to the law officers in cases of collision. The salary of the Hydrographer was to be £1 500, inclusive of half or retired pay.

On the duration of appointments, permanency was recommended for the

Assistant Hydrographer, the Superintendents of Charts and Sailing Directions, and the Notices to Mariners Officer; and two to three years for others, which thus brought sea experience to the office and vice versa. Such experience would be very valuable to the assistant in Chart Branch and the officers on special business and special investigations. Tizard showed some concern that too long an absence from the sea might impair the skill and nerve-power of an active-service officer. The committee noted that the employment of captains as heads of branches with increased salaries would improve the prospects of surveying officers by their earlier employment in charge of surveys. However, the near future saw the only permanent appointments as those of the Superintendent of Sailing Directions and the Notices to Mariners Officer. Several posts were recommended for either (H) or (N) officers, such as those in Sailing Directions or Chart Issues Branches, or for an (N) officer, as in Light Lists Branch.

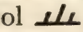
On the matter of the secretariat, the committee heard from Barber of the value of the Chief Civil Assistant's post being held by a permanent civilian, so that on a change of Hydrographer, the traditions of the department could be better carried on. Questions put to him concerned the department as viewed from a manufacturing standpoint, and Barber showed how, unlike his naval predecessors, he had had the opportunity to acquaint himself with other departments, and had thus been able to suggest various reforms and savings. A new and more favourable agreement had been made with Malby, the printer, in 1905. Some printing work had been found more properly a charge on H.M.S.O.; Naval Intelligence Division's Confidential printing had been transferred to the Ordnance Survey, who did such work for the War Office. The examination and reconstitution of returned chart sets by two additional packers, temporary since 1905 and now established, was a considerable saving. Proposals were being made to increase chart prices, and the agent had agreed a discount of thirty per cent instead of forty per cent. The use of heliozincography had shown, in 1904, that plates could readily be made from dry proofs stored at the Admiralty or the British Museum, and this was a less expensive way of insuring against disaster than the duplication of copper plates, whose correction had in any case fallen into arrears. Photo-etching of coppers was being introduced; and more photography was being used in Chart Branch. Some £10 000 a year could thus be saved.

Barber argued strongly for the supervising second-division clerk, Llewellyn, to be made a staff clerk, the only one of that rank in the department being on pilotage accounts. The committee proposed the net addition of one second-division or staff clerk, and a hired clerk; but the Treasury agreed only to the latter, adding that the two assistant clerks should ultimately become hired clerks. It was also agreed the Chief Civil Assistant's salary should continue at £550–650, but increments should be £20 annually instead of £50 quinquennially. A later attempt by Field, in 1907, to get a further increase in Barber's salary, and a memorial in 1908 by Chapman, Jefferson, and Llewellyn for the creation of minor staff posts, were unavailing. Llewellyn, however, received a special increment to his salary in July 1909.

The transfer of Compass Branch to the Controller's department was not favoured by the committee. Tizard argued that that part of its work on terrestrial magnetism must be with the Hydrographer, although the material side could come directly under the Controller. Chetwynd, the superintendent, advocated the opposite arrangement; and a change came about in 1911. The committee said that the superintendent should be a commander (N) and permanent. It also proposed two staff changes: the temporary third officer (appointed in 1906 following a large number of magnetic observations in the Atlantic) should be replaced by a hired clerk to assist with computations, now that visits to ships took up less time owing to the greater use of naval rather than private shipbuilding yards; and the compass examiner at Deptford should be a warrant-officer. These two changes were agreed. Foden, examiner since 1883, was succeeded in 1907 by Alexander, a boatswain who had been an assistant surveyor in the *Sealark*.

Purey-Cust became Assistant Hydrographer in October 1907, replacing Tizard, whose long and distinguished service was rewarded with the grant of a captain's pension. Pasco succeeded Stanley as Superintendent of Charts in February 1906, the latter's outstanding contribution since 1879 being clearly reflected in the statistics already mentioned. Learmonth took over from Pasco in April 1908, and was followed by Glennie in March 1909.

Much has been said about the output of Chart Branch. The fall in the number of new charts was offset during 1906 by a large increase, to some 500 in the number, of plates largely corrected; and the number of navigational charts continued to mount, reaching 3 650 in the 1910 catalogue. The 1905 catalogue gave charts a second, ' new ', number in parentheses, running consecutively from 1 to 3 437 through the navigational charts. There had been similar numbering five years previously, and on both occasions the gigantic task of any renumbering presumably proved too formidable. The re-use of the number of a cancelled chart for a new chart, perhaps of another area, had been the practice for some fifty years. A new production for Fleet use in 1908 was a set of Fishery charts showing concentrations of vessels for each month of the year in home waters, prompted no doubt by the large number of claims that appeared in the records for compensation from fishermen with damaged nets.

There were no marked changes in cartographic styles except that sloping print was used for water features; and the wreck symbol , accompanied by a year-date on large-scale charts, was adopted in 1908 at the instigation of the Board of Trade, who had suggested the use of large dots. The additional draughtsmen were accommodated in the old building. Engraving continued in the hands of the two firms, Davies and Weller; and the dimensions of charts within the inner graduation or border lines, were now engraved on the plates at the bottom right.

In May 1906 a new system was begun for recording the corrections to chart plates in sixteen volumes, the 'Chart Histories'. An assistant clerk worked overtime to complete them in October and they replaced the journals begun in 1861; and subsequent developments in this procedure have been described on pp. 76, 100 and 125. Also in 1906, the promulgation of lists of new charts and so on became monthly instead of bi-monthly. Important changes were made in 1908, as shown in the 1909 edition of *Notes bearing on the Navigation of H.M. Ships*, which stated that the dates of large corrections were now inserted on the plates under the heading of 'New Edition'. Those correcting charts were enjoined to insert (in red) the numbers and dates of Notices to Mariners at the bottom-left corner only, since otherwise they tended to increase illegibility. Temporary Notices had been introduced, and were to be marked in pencil. There was the comment that charts of the same dating could differ by reason of the insertion on the plates of corrections not affecting navigation and not promulgated by Notice.

In January 1909, Chart Histories, which had used 'Cancel all' to show the need to replace all copies of a chart cancelled by a new edition, now had entries 'Cancel PPD'. This initiated the procedure that has since been used when a heavy correction, such as one promulgated by 'Block Notice', threw too heavy a burden on the manuscript correctors of stocks of the affected chart. New printings from the corrected plate replaced copies in the presses, at Potter's, and in the depots.

The increasing use of Notices to Mariners has been mentioned on p. 213, and in 1907 the device of issuing portions of charts with the new work shown in red was adopted; the Japanese in 1904 had been the first to use such Block Notices regularly. In 1907, also, a daily distribution of Notices to the Home and Atlantic Fleets was instituted, and a year later it required another packer—the only increase in the staff during the period, beyond those already mentioned. There occurred the first record of the Admiralty's thanks being sent to a merchant vessel, together with a complementary copy of the Notice that promulgated a reef the vessel had discovered.

The correction of Sailing Directions was facilitated by the issue of annual summaries of Notices affecting them; and for those who purchased Sailing Directions, a coupon was inserted from 1908 authorizing the gratuitous receipt of correctional material, though the Treasury required that the sale prices should be adjusted to cover the cost. In that year, Sailing Directions began to embody views. Remark Books continued on issue to the Fleet, but in 1909 the instructions for their dispatch to the Hydrographer were amended, so that when no entries had been made, a certificate to the effect was rendered. The annual reports from 1906 to 1912 listed the officers revising Sailing Directions or supplements; nine were so employed.

The ten Lists of Lights were reset during 1909 in order to meet an H.M.S.O. requirement; and a naval assistant (N) was appointed for a period of four months to achieve this change.

In 1909, there was the first issue of *Tides and Tidal Streams of the British Islands and North Sea including the North Coast of France*, which contained a co-tidal chart by Tizard. The Tide Tables were called Volume I, and no longer contained tidal-stream information. Just before the end of the Field period, negotiations were begun with the Indian and colonial Governments for the supply of advance proofs of their publications, so that details of their ports could be included in the Admiralty Tide Tables.

Also in 1909, in view of information promulgated by the Controller, the Hydrographic Department Dock Book was withdrawn, although certain details were continued in Sailing Directions.

In 1906 charts were printed on pegamoid for torpedo-boat destroyers and torpedo-boats in home waters, but they needed waterproofing with varnish after correction, and were abandoned in 1908, although later years were to see another experiment for small craft.

Chart printings practically reached the half-million mark in 1909. In May 1906 the Hydrographer supported the Commander-in-Chief's case for a petty-officer pensioner at the Gibraltar depot by referring to the Sheerness, Portsmouth, and Devonport depots, each of which held 35 000 charts and had a staff of three civilians or pensioners. At Malta there was one pensioner for 11 300 charts, the same number of charts being held at Gibraltar. In 1907 the Treasury sanctioned an increase of two pensioners as civilians at Portsmouth, and one each at Sheerness and Devonport, Sheerness becoming a chronometer depot that same year. In 1908, extra pay was made a continuous allowance of one shilling to one shilling and sixpence a day to officers-in-charge at the five main depots, the Hydrographer having pressed for the various staff improvements on the grounds of the need for experienced men in the event of mobilization. In 1909 the chart and chronometer depots at Portsmouth were amalgamated, with a staff of one officer and five pensioner civilians.

In April 1907, an Admiralty circular letter revised the regulations so that chart sets afloat should be better corrected and be available for transfer. An age limit was set at four years, or three for destroyers; and supply and transfer certificates, folio lists and date stamps were established.

The increased prices of charts, approved in December 1905, raised a DE size from two shillings and sixpence to three shillings, and a ½DE from one shilling and sixpence to two shillings, and in April 1906 Potter accepted a complementary reduction of his discount from forty per cent to thirty per cent in a new agreement. The Hydrographer reported in July 1907 that the year ending March 1907 showed sales receipts up by £9 549 to £27 577, the agent's discount being down by £200 to £11 819. Sales had fallen by 80 000 charts below the phenomenal level occasioned by the Russo-Japanese war, but higher prices had avoided a fall in receipts. A minute of 1904 indicates how the Russian Hydrographic Department appreciated the way in which Potter had executed their orders, and the Board felt that his acceptance of a presentation was no concern of the Admiralty.

A precedent was established in 1909 when cancelled charts were presented to the School of Geography, Oxford. The Treasury approved, H.M.S.O. also, provided that a sufficient number of linen-backed copies were kept to provide folio covers. The annual list of charts presented gratis was challenged by the Exchequer and Audit Department, so Field pointed out that some had been established by Act of Parliament, some were on an exchange basis, and others were as advertisement.

In November 1906 the Hydrographer commented on a proposal from Mr J. Schlade about the metric system. He said that it had been arbitrarily adopted by nations conquered by Napoleon and that it could not express halves and quarters, the terms in which people thought. If it were taught in schools and the Government adopted it, the Admiralty would have to consider altering their charts. In June 1907, the U.S. naval attaché made the suggestion that the two countries should reciprocally exchange chart plates. The Hydrographer saw practical disadvantages in the differences of sizes and styles, and also many economic drawbacks in any exception to the accepted practice by which each hydrographic office reproduced, in whatever form it pleased, the charts of others. The Board briefly declined the suggestion.

Special charts were produced for the assembly of the Home Fleet in the Thames, followed by a royal review at Spithead in July 1909. To meet a public demand, and rather than allow a private publication, an edition costing one penny was produced.

These comments on the production of charts and books during this period conclude with the details of another appeal by Field in February 1909 for additional staff, six months before he turned over to Purey-Cust. He said that, despite the great increase in the Fleet and the charts required, as well as the many additional questions of navigational defence, there had been no increase in the naval staff of thirteen for twenty years. More work was, however, being done, and could be done, by clerical staff. He asked that Chart Branch should be increased by one naval assistant and one assistant clerk, Sailing Directions Branch by two naval assistants and one hired clerk, and Chart Issues Branch by one hired clerk. The upshot of this request is discussed in the next chapter, as also is the recruitment of cartographers, in which grade there were nine vacancies by the end of 1909.

There were various developments of navigational equipment, the Hydrographer referring to the Navigation School for trial and report. In 1904 there was the submarine signalling-apparatus of a Boston (U.S.A.) company for the location of lightships in fog, and perhaps, as the Hydrographer suggested, for communication between submarines. Trials were followed by ship-fitting in 1908, by which time Trinity House had installed bells in various lightships. Thomson (Kelvin) sounding-machines were improved, an electric motor being added in 1906; and the adoption of stranded wire gave a greater uniformity of egress, with the result that speed and depth tables were more accurate. Tanner-Blish tubes, the alternative to the chemical type, were finally discarded in 1908 because no satisfactory drying equipment could be developed. That same year, trials were abandoned of sounding through a standpipe in the keel, as proposed by Kelvin for ships at action stations, since there was no avoidance of the wire's being cut by the propellers. In 1905 the Hydrographer had advised that Burt's and Massey's machines should no longer appear in Admiralty lists.

Various logs continued under trial, Walker's Neptune high-speed type being favoured, with electric recording a possibility. The Forbes underwater log began trials in 1907, and in 1909 the Hydrographer held a meeting with Elliott Brothers to discuss the final improvements. Navigational rangefinders were on issue to flagships, and the Battenberg course-indicator and Martin's mooring-board were in use. In 1906 Field recommended balloon experiments in the naval service but the Director of Naval Intelligence thought their development was insufficiently far advanced.

The Compass Branch was active under Chetwynd, the superintendent from 1904. His improved liquid compass was the subject of a long report in November 1906 when he proposed taking out a patent, which would demonstrate how he had cooperated with Messrs Dent and embodied the improvements of Creak, his predecessor, how Kelvin's compass was too sensitive under gun-fire despite certain remedies, and how an enlarged bowl and a steering-prism in lieu of the lubber's line had finally established the improved liquid compass, alternatively known as the Chetwynd/Dent compass. Kelvin and White continued to make the binnacle, as well as a transparent bottom to the compass bowl for lighting from below, to Chetwynd's specifications. This arrangement is well shown in a historical review by the Hydrographer in November 1908 when Dobbie and McInnes, who incidentally challenged Chetwynd's patent, proposed a reduced-diameter compass card, which, however, was not adopted.

In 1907 there were trials of Pollen's gyroscopic compass, and in February 1909 there was a minute on the German Anschutz in which the Hydrographer thought it an instrument that could never entirely supersede the magnetic compass. He said there did not appear to be any demand as a navigational instrument but referred the proposal to the Director of Naval Ordnance. In answer to a parliamentary question of April 1909, the Hydrographer said the Anschutz compass had originally been brought to the notice of the Admiralty in 1905 when the superintendent had attended trials at Kiel. Experiments had been made, and now, in agreement with the Assistant Director of Torpedoes, trials were begun, and continued in July.

Field sought the assistance of the Fleet in observations for terrestrial magnetism; and Barrow dip-and-force instruments were supplied to flagships for use as opportunity occurred. Instruction in the use of the instrument was given at the Navigation School. The officers of H.M. Ships *Cambrian* and *Flora* received Their Lordships' approbation for measurements of total force, inclination, and variation when on a Pacific cruise in 1906; and in the same year three ships on a South American cruise had instructions to observe both afloat and ashore. The First Cruiser Squadron swung ships for variation when crossing the Atlantic in 1907.

Staffing matters at the Royal and Cape Observatories were, as formerly, handled by the Hydrographer, and in 1908, when the Board of Visitors recommended that established computers should become junior assistants, Field wrote that it was essential a determined effort should be made to induce the Treasury to make this change. There was much discussion of the effects at Greenwich of the London County Council's new generating-station, which attracted notice and also a resolution at a meeting of the International Astronomical Society. In 1908 Field was able to make a successful case for the restoration of Halley's monument at Greenwich.

Gill, who had retired from the Cape in 1906 with a gratuity of £1 000, wrote a report in December 1908 on the dangers of a Treasury proposal that the observatory should be transferred to the colonial Government. He said that the colony would be unlikely to vote sufficient money and that there would be a tendency to cultivate the popular rather than the fundamental aspects of the science. He added that there was no reason why the scientific honour of England should not be at least as dear to her now as it was in 1820 when the observatory was set up by the Board of Longitude.

In February 1908 the longitude of the Cape Observatory was redetermined through Ascension Island, where Monro, in the *Mutine*, assisted by Gibson, observed with a portable transit-instrument lent from Greenwich Observatory. Before leaving England in October 1907, the two observers had received instruction at Greenwich and compared their personal equation with Pett, an assistant at the Cape Observatory; and on the *Mutine*'s return to Plymouth from her West African surveys in July 1908, they again visited the observatory to redetermine their personal equation and to draw up their report. The annual report for 1908 acknowledged the assistance of the Eastern Telegraph Company in the direct exchange of signals between Ascension Island and the observatories at Greenwich and the Cape. In December 1908 it was agreed that the Cape Observatory should make photo-recordings of sunspots for terrestrial-magnetism purposes, since observations at both Dehra Dun and Mauritius had ceased.

Additional time-balls were established, e.g. at the Castile, Malta, at Portland, and at Chatham. New chronometer stowages having springs and fillet-pieces were designed in 1908, and hack-watches came into service. In 1906 the Hydrographer did not think the expense of a daily time signal from Poldhu wireless-telegraphy station, which had sent the first transatlantic message to Newfoundland in 1901, was justified, since ships that could receive them would be those with good chronometers; but there was further discussion of wireless-telegraphy time signals in 1908. In 1905 there were arrangements to assist with transporting the expeditions of the Astronomer Royal to Sfax and of Lockyer to Palma, Majorca, for observations of a total eclipse of the sun. In 1909 the longitude of Malta was redetermined; and Lieutenant

Hanning Lee had two months' instruction on a transit-instrument at Greenwich before he succeeded Roberts at the Malta chart-and-chronometer depot in 1906.

The Hydrographer obtained, in 1905, an increase from £650 to £700 in the maximum salary of the Superintendent of the Nautical Almanac Office, but it was personal to Dr Downing, who had held the office since 1892.

The Meteorological Council became a purely advisory body in 1905. The Hydrographer continued to be a member, but, fearing that the close relations with his department might be disturbed, he asked that the now autonomous Director of the Meteorological Office be given appropriate instructions. He recalled the institution of the office and the proposal that the department should undertake marine meteorology, which the Board had declined. He explained that the end in view was the promulgation of information for the use of seamen, for which departmental publications were specially suitable. The Meteorological Office provided the data for Wind and Current charts, and the statistics for Sailing Directions as well as special wireless-telegraphy weather-forecasts for the Fleet, i.e. destroyer flotillas begun in 1904. In return, the Admiralty arranged observations afloat and at coastguard stations. Military Branch discussed the difficulty with the Treasury, and it was agreed that an official letter was not necessary since there was no intention of disturbing the former arrangements.

Instruments for the Fleet continued to be supplied by the Meteorological Office, distribution being arranged by the Hydrographic Department, and costs being borne by Navy Votes. At the request of the Director, Meteorological Office, ships were ordered, by a circular letter in 1906, to transmit weather data according to a Meteorological Office code, when they came within range of an Admiralty wireless-telegraphy station; and outward-bound vessels were included in the following year, when the Meteorological Office was well pleased with the arrangement. Barographs were supplied to flagships, since continuous recordings were of scientific value; and in 1909 the Admiralty passed Meteorological Office weather-reports to selected R.N. ships to encourage an intelligent interest in weather-forecasting. For the same reason, Field strongly supported the first request, coming from Commander F. G. P. Butler in 1909, for a meteorological course, saying that a knowledgeable naval officer would have opportunities never open to most meteorologists. In 1907 the Hydrographer, at the Meteorological Office's request, arranged with the Admiral Superintendent, Gibraltar, for observations to be made of eddies brought about by wind striking a cliff face.

An international convention on collision regulations, assistance and salvage at sea was drawn up at an International Maritime Committee in Brussels, October 1905. Men-of-war were exempt, but the Treasury Solicitor assumed that the Admiralty would acquiesce in the event, and the Hydrographer advised that there was no objection as far as naval interests were concerned. The minute-books contained many reports from H.M. ships of contraventions of the collision regulations by merchant vessels; and the Hydrographer held a meeting with representatives of the Board of Trade in 1909, at which some amendment to the Merchant Shipping Act was agreed to be necessary. The Board of Trade, however, found it difficult to reach a decision, and the file continued into 1912. In 1910 there was a suggestion that the Admiralty should sponsor a Bill, and Purey-Cust, then Hydrographer, referred to the Admiralty as ' the largest shipowners in the world '.

Questions on territorial waters featured more frequently in the minute-books; limits were shown, together with additional natures of the bottom, on Faeroe Islands charts for the benefit of fishermen in 1906. In 1907, when a Norwegian notice to mariners alluded to a four-mile limit, it was referred to the Foreign Office; and the next year, when a similar limit was put on charts of Iceland, the notation ' As claimed by the Danes ' was added. There was an interdepartmental committee on the territorial waters of The Wash from 1906 to 1909 when their conclusions were shown on a chart cutting in the minute-book. The waters round the Eddystone and Casquets also received consideration.

The charting of telegraph cables was another problem occasioning an interdepartmental committee in 1908. The previous ruling not to show them on charts was confirmed, despite the damage from trawlers, which was attributed to the use of faulty trawling-gear. Stouter cables were the only solution. An exception was made for charts of examination anchorages, on which cables, in so far as they lay within the defences, were shown.

The Hydrographer continued to advise the Foreign Office and the Colonial Office on matters of sovereignty in the Antarctic, where there were the claims of Argentina, and also in the Pacific, where there was the case of Cartier Island; and instructions followed to Pasco in the *Fantôme*, who thus, when two days out from Thursday Island for Broome, did a running survey and annexed the island to the Crown on 17 May 1909. Field advised against the sale of Fanning and Washington Islands in 1908 on the grounds of their value in light of the forthcoming Panama Canal. The lighting of the Persian Gulf occasioned discussion from 1909.

It is of interest to note that Field strongly opposed the Thames Harbour Bill of 1905, with its proposal for a dam at Gravesend, and in 1908 he thought it a delusion that there could be a Forth-Clyde canal capable of taking damaged battleships from Rosyth to the Clyde shipyards. There were minutes showing the increasing use of oil fuel by the Fleet; and the Hydrographer advised that a fleet-auxiliary oiler should have less than a twenty-foot draught for entering east-coast ports.

In 1907, after a year of discussion, the Wharton Testimonial was promulgated in an Admiralty circular letter. It was associated with, but in no way altered, the Beaufort Testimonial and provided for the winner to purchase an instrument or technical publication useful to a navigating officer, with the addition of a gold medal bearing a bust of Wharton.

At long last, in 1908, an official librarian, W. G. Perrin, was appointed and in response to a formal, headed, reference sheet, then coming into use, the Hydrographer handed over to the library several valuable books, such as *Cook's Voyages*, which had been kept in the Chief Civil Assistant's room for want of a better place. In 1910, in anticipation of the move of the library into the Archway, the Hydrographer asked that the rooms vacated in the dome should be allocated for the original documents, which were suffering damage in the attics. Moreover, Compass Branch could return from Abingdon Street. By 1911, however, original documents were in the sub-basement, and Compass Branch was separated from the Hydrographer.

When, also in 1908, the Hydrographer received notification of the Eleventh Congress of Navigation at St Petersburg, he said that it was of more concern to the Board of Trade than the Admiralty. However, at this congress the holding of another international conference of seamen and engineers, with the object of introducing uniformity into hydrographic publications, was proposed; and an account of this step towards the International Hydrographic Conference of 1919 is discussed under Parry's period as Hydrographer.

Progress of marine surveys

Annual reports to Parliament continued to describe the work of the various surveying ships and parties; and a tabulated digest for the years 1904 to 1909 is given on pp. 236 to 247. Field, like his predecessor, commented in 1904 and 1905 on the remarkable fact that the number of dangers to navigation discovered each year increased, and that while such was the case, the need was obvious for more numerous and more detailed hydrographic surveys, which would also meet the growing requirements of commerce, some of which had sprung up in imperfectly surveyed areas. A maximum figure of 522 such dangers was reached in 1905, of which 145 were found by surveying ships, 26 were struck by vessels, and 322 were reported by colonial and foreign Governments. From 1907 a record of reported dangers disproved and expunged from charts was begun, the figure for the year being thirty-nine.

Reference has been made to the increasing needs of the Fleet in home waters. Surveys were carried out by the *Research*, Smyth followed by Simpson, and the *Triton*, Purey-Cust followed by Pudsey Dawson; there was also the south-coast-of-England survey under Haslewood in either the *Endeavour* or *Sir James*, both hired vessels, and a west-coast party under Maxwell, Combe, and Somerville successively, in the hired vessels *Gladiator* and, later, *Argo*.

The *Research* was almost entirely employed in the lochs on the west coast of Scotland, and in 1908 surveyed north and west of Cape Wrath. The *Triton* was chiefly on the east coast and in the Thames estuary, where the changes in the Duke of Edinburgh Channel were less marked than formerly; but in 1904 she too was on the west coast of Scotland at Rothesay Bay and Ballachulish. From 1905, part of each season was spent in the Orkneys, surveying Scapa

Flow and the Pentland Firth. Both ships were engaged in many tidal observations. The report for 1905 described the manometer, a pneumatic gauge tested by the *Triton*, which it was hoped would be useful on shelving beaches and, when fitted with a recorder, would obviate the necessity for tide-watchers in unhealthy places. In 1907, the *Research* spent much time unsuccessfully endeavouring to measure tides at mid-Channel positions by continuous soundings, but they needed particularly fine weather. In 1908 and 1909 the *Triton* was successful at a depth of thirty-five fathoms in the Pentland Firth, and also in the English Channel, with a pressure or pneumatic apparatus; and in the latter year the Field/Cust tide-recording apparatus[1] was tried in the Orkneys, and needed only small improvements.

The *Gladiator*, succeeded by the hired steam yacht *Argo* in 1908, also surveyed in the lochs on the west coast of Scotland and in the Outer Hebrides. On the Irish coasts, Youghal Harbour, Rosslare, Donaghadee Sound, and Lough Swilly were surveyed; and besides work in the Scilly Isles, King Road in the Bristol Channel was re-sounded. The south-coast-of-England survey was fully occupied at Plymouth, Portsmouth, Tor Bay, and the new Admiralty harbour at Dover.

The Hydrographer, referring in July 1907 to the event of mobilization, said that the *Research* should remain in commission, since, in war, she could find and mark channels in enemy waters from which beacons and buoys might have been removed.

Many harbour authorities were making their own surveys, and exceptionally, as in the case of the river Shannon in 1909, the Hydrographer was prepared to provide an officer if the local authority supplied the boat. He instanced Combe's survey of Sligo Harbour in 1905.

Abroad, the number of ships continued at six, though not without effort on the part of the Hydrographer. The *Sealark*, a converted composite ship of 900 tons, was commissioned at Portsmouth in September 1904, the year in which *Dart* was paid off. In 1906–7, *Rambler*, *Goldfinch*, and *Penguin* were replaced by *Merlin*, *Mutine*, and *Fantôme*, which, converted either at Chatham or Sheerness, were of around 1 000 tons, with an increased horsepower of 1 400. They had yards and sail, carried two steam cutters, and were to be the last of the wooden-sheathed, copper-bottomed ships[2]—a construction that, besides affording some protection if a ship grounded in unsurveyed waters, provided preservation to bottom-plating with less frequent docking, a problem later to be overcome by anti-fouling compositions.

In May 1908 Field, foreseeing that the *Egeria* could not last more than two years, unavailingly proposed a new construction of 1 000 tons having a speed of 13½ knots, costing £65 000, and requiring eighteen months to build. In December, when the *Egeria* was unfit to be transferred from British Columbia to Australian surveys, and the *Fantôme* had to be substituted, Field, on requesting the Board for another ship, insisted that a sheathed ship was essential. He argued that the proposed use of a merchant vessel was impracticable, since none could be found that had a phosphor-bronze stem and stern-post, necessary for the addition of copper sheathing if galvanic action was not to set up. In submitting the urgent necessity to maintain the existing number of surveying ships, Field said that the interests of the merchant marine were seriously concerned, and that without proper charts the rates for insurance were so high as to be prohibitive, hence the Western Australian request for surveys. Other applicants were Cape Colony and Natal, Ceylon, Straits Settlements, and British North Borneo. British shipping and mercantile interests relied on Admiralty charts and, as a *quid pro quo*, H.M. ships had exemption from light dues. After Field had reiterated that he was not asking for a seventh ship, the First Sea Lord minuted to the First Lord in December 1908: ' A successor to *Egeria* is not required for two years. If there is no suitable vessel (I can't understand the difficulty) and if you are still of opinion that a new surveying vessel should not be built then the conversion of some old sloop can stand over till next year.'

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[1] See *Hydrographical Surveying*, third edition, 1909—Bibliography 2, 5.

[2] Copper-bottoming had first been used in the mid-eighteenth century.

Surveys of colonial waters took a prominent place in these minutes, and there had been much discussion of the reaction to the proposals made in 1904[1] to Australia, Canada, New Zealand, and Cape Colony that they should conduct their own surveys. In March 1907, Field prepared a memorandum for a forthcoming Colonial Conference. He appreciated the Colonies' difficulties in obtaining qualified officers (R.N. officers were unwilling to go or were too few), seamen whose wages would not be too high, and wooden-sheathed ships (which could not be purchased). He considered that, because of the benefit to H.M. ships and Imperial trade, the Treasury should agree to a colony's paying less than the previously negotiated half share of the cost of an R.N. surveying ship (£15 000 annually), whereupon a priority could be established, which, however, would put naval needs first. The matter was not in fact discussed at the conference, and in June 1907 a further letter was sent through the Colonial Office to Australia, New Zealand, and the Cape. Canada[2] had already agreed to accept responsibility, and was understood to be building a ship for the Pacific coast—shown by a reply to a parliamentary question in 1907—and information of both her coasts was being regularly received by 1909 from the Department of Marine and Fisheries.

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[1] See p. 137.

[2] Canada set up a Hydrographic Survey in 1904 with Mr W. J. Stewart as Chief Hydrographic Surveyor, though he preferred to be known as Chief Hydrographer. It was under the Department of Marine and Fisheries until a reorganization in 1930, except that from 1910 to 1922 it was under the Department of Naval Service. The first ship to be specially built was the *Lilloet* in 1908 in British Columbia for surveys of that coast until 1933. Her sister ship, the *Cartier*, was built in England in 1910 for the St Lawrence and Atlantic coast until 1939, where her predecessors had been *La Canadienne* and *Bayfield*. The first engraved Canadian chart from Canadian surveys was published in 1909 and was of the St Lawrence.

New Zealand replied that Commander Sinclair, R.I.M., had been engaged to advise. He had found no Government steamer suitable, and had suggested one of three Imperial sloops at Hong Kong, which, however, the Admiralty had not been prepared to release. New Zealand had accordingly, and with reluctance, given up the survey, but intended to bear in mind the Admiralty offer to train surveyors. Cape Colony appreciated the need, but was unable to meet the cost, as is shown by the Hydrographer's reply to the request of the Union Castle and other lines in 1908; and in 1909 the provision of finance was still under consideration. Australia agreed early in 1908 to contribute half the cost as formerly; and the *Egeria* was allocated. She had to be replaced by the *Fantôme*, as has been stated; and the need not to break faith with Australia was one of the Hydrographer's arguments for another ship.

Other pressure for surveys came from the Foreign and Colonial Offices, with the result that the Kroo coast was undertaken by the *Goldfinch*, 1904–6, and the Solomon Islands for a part of each season by the *Fantôme* from 1909. In 1906 the Hydrographer replied to the Merchant Service Guild that surveys were made by H.M. ships in the Persian Gulf (where Royal Indian Marine responsibility was in doubt), and he advised the Board that they would be of more value when done by (N) officers who had spent two years in a surveying ship, as they became available. In 1908 he suggested that one such officer should meet the request for a survey of Stromness Bay in the Falkland Islands; and in the same year he asked the Senior Naval Officer, Newfoundland, to assist Dr Grenfell with astronomical positions in Labrador.

The activities of surveying ships abroad during the period were as follows. The *Egeria*, Parry, later Learmonth, continued surveys off British Columbia, losing the services of Lieutenant I. B. Miles in 1905 when he joined the Canadian Government on Canada's assumption of hydrographic responsibility, as mentioned. The *Ellinor*, Tooker, later Combe, carried on with the coasts of Newfoundland. The *Sealark*, newly commissioned by Somerville in September 1904, did some work in the Red Sea on passage to the Indian Ocean, where she undertook a six-month scientific cruise, exploring various coral-islands and submarine banks, with Messrs Gardiner and Cooper embarked by arrangement with the Royal Society. From 1907, under Davy, she was on the coasts of Ceylon. The *Waterwitch*, Glennie, was on the China Station, off the Shantung Promontory, and in the approaches to Hong Kong until 1908, when the disturbed state of China caused her diversion, now under Douglas, to the Straits Settlements, Singapore, Swettenham, and the Malacca Strait.

The *Goldfinch*, Learmonth, later Walter, was mainly on the Liberian coast of West Africa but doing alternative work in the Mediterranean. In 1905 she made a survey of Gibraltar Strait to determine sites for more accurate observations of currents than those of 1871 and to assess ' the relative amounts of water pouring in and out of the Straits at any one time and also at different depths '. The *Mutine*, Monro, succeeded her in 1907, but before leaving home waters she obtained successful tidal observations by means of soundings in the Channel between Portland and Cape La Hague. Her observations at Ascension Island for the longitude of the Cape Observatory have been described, and during a visit there again in 1908 for health reasons, she was diverted to Bissao in Portuguese Guinea where the natives were in revolt. Her assistance was not required, but in 1909 she spent a fortnight in Monrovia protecting British subjects. On her passages to and from Plymouth for refits she determined the 100-fathom line off Spain and Portugal, and in 1909 she sent a party to Tor Bay to examine a rock off the Ore Stone that had been touched by H.M.S. *Hannibal.*

The *Rambler,* Monro, was alternately on the south-east coast of China and in Borneo waters until 1906, in which year she finally paid off at Hong Kong after serving as a surveying ship since 1884. A suggestion that she might be offered to Australia was, not surprisingly on account of her age, rejected by the Hydrographer. The *Merlin,* commissioned by Parry late in 1906, took up the *Rambler*'s Borneo surveys after surveying Mohammed Ghul in the Red Sea and visiting Socotra. In 1909 she joined the hunt for the noted Sulu pirate, Jikiri, who was being pursued from the Philippines by U.S. men-of-war, and who was finally accounted for by them on Patian Island, although not before the *Merlin* had sent armed cutters, British North Borneo Constabulary embarked, up the Kinabatangan River.

In Australasia the effort had begun to tail off at the end of the Wharton period pending discussion of the Colonies' assumption of responsibility. The *Penguin,* Simpson, likewise discontinued her surveys in New Zealand, which had been on the basis of shared costs, in February 1905. She then carried on the surveys on the north coast of Queensland and also in Tasmania until the end of 1906, when she finally paid off. The *Fantôme* was her successor, under Hardy and later Pasco. Outward bound in 1907, she surveyed the Strait of Jubal, Ashmore Reef in the Timor Sea and other shoals *en route* to Thursday Island and her work on the Queensland coast. This was continued in 1908, alternating with work in Tasmania; and in 1909, two days out from Thursday Island on the way to her main task on the north-west coast of Australia, she surveyed and annexed Cartier Island, as has been mentioned. Her return to Hobart was made via Fremantle; she had thus circumnavigated the Australian continent.

The regulations regarding surveying ships' activities remained unchanged, and in 1906 stated:

> Although a surveying ship is to be considered under the orders of the C.-in-C. of the station on which she happens to be, her programme will as a rule emanate from the Admiralty. Should it be necessary to divert her from her important duties for the good of the service, full particulars are to be reported to the Admiralty by the senior officer so acting. A surveying ship is not to follow a senior officer's evolutions for exercise.

Parry's position as Senior Naval Officer, North-west America, was raised in 1906 after his promotion to captain. When he was again in the *Egeria* in 1908, and under orders for Australia, which were subsequently cancelled, he asked to be an independent ship, but Field did not agree. In 1909, Field had to resist, as a dangerous precedent, a proposal from the Commander-in-Chief, China, that the *Merlin* should be used for a cruise by the Governor of the Straits Settlements.

Some tasks were undertaken by individual surveyors. Combe surveyed Sligo Harbour in 1905, and the next year set up a calibrating range for the Fleet at Platea in Greece, after which he carried out a triangulation at Malta. In 1907, Parry, on his homeward passage from sick-leave in Tasmania, followed up this triangulation, because it was found impossible to fit the Ordnance Survey coastline to Combe's triangulation. Parry also surveyed the Marsa Scirocco torpedo-range, spending some six weeks on the island. Spicer-Simson, later to be Secretary-General of the International Hydrographic Bureau, was given instructions in 1906 for the triangulation of the Yangtze above Ichang, subject to the Commander-in-Chief's approval.

The Marine Survey of India continued surveys on the coasts of India and Burma, in the Andaman Islands and in the Persian Gulf, e.g. Kuwait in 1906. Its responsibility for the Persian Gulf was in doubt when the maintenance of Indian tide-gauges at Kuwait, Bahrein, and Bushire was reviewed in 1906. It was in that year that a Royal Indian Marine officer, Commander W. G. Beauchamp, took charge of the survey. He spent a month in the department in 1907 when the *Investigator* was replaced by a new ship of the same name, built in England, and the tender *Nancowry* was replaced by the *Palinurus*.

Magnetic observations received much attention at home and abroad, as already noted, and surveying ships played their part. It became the practice to send surveying officers for courses at Kew and Deptford. Ashore, the Barrow dip-circle was used, and afloat there were swings for variation in many seas and oceans.

The Hydrographer reviewed activity in oceanography in 1909, when a resolution at an international geographical conference on the exploration of the sea[1] was referred from the Foreign Office. He appreciated that a study of the Atlantic was of great scientific interest and of practical importance to fisheries. Having recalled what had been done by the *Challenger* and more recently by the *Sealark* in the Indian Ocean, he thought it impracticable to divert an existing surveying ship, apart from which, the time was inopportune for the appropriation of another vessel. It was therefore undesirable for the Admiralty to be associated with the proposals.

Previously, in 1907, in response to the Royal Society's request for Dr Fowler to work in H.M.S. *Shearwater* off British Columbia, he was forced to reply that the ship had no suitable winch, and that the *Egeria* could not spare the time. He referred to the Canadian Government's intention to build a surveying ship.

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[1] An earlier [the Seventh] International Geographic Congress in 1899 had supported the resolutions of a conference of countries bordering the North Sea and adjacent oceans, held the same year in Stockholm under the patronage of King Oscar II. These resolutions were further discussed at Christiana in 1901 and led, in 1902, to the constitution at Copenhagen of the International Council for the Exploration of the Sea (I.C.E.S.).

Conditions afloat were better. Two-year commissions were in force and ships' programmes included changes of survey ground to give relief from bad climatic conditions. The *Goldfinch* had forty men down with malaria on the West African coast in February 1904, and in the following year her entire crew had landed to recoup from fever in a military camp on Mount Aureol, 800 feet high, in Sierra Leone. On occasions, the naval camp at Diyatalawa in Ceylon was similarly used. Chinese, seedy boys, and Kroo-men were signed on for work in high temperatures, and stoker ratings received extra pay in the tropics. The new ships, *Merlin*, etc., had ice-machines and fans. Ships abroad were painted white, with yellow masts and spars, for the same reason as previously, i.e. the safety of boats working away from the ship. The *Triton*, however, was painted black instead of grey in 1906.

The number of surveying officers afloat varied between fifty and sixty. There was a shortage of volunteers, so that the Hydrographer had to ask for watchkeeping officers to be appointed from time to time. Field said in 1904 that slowness of promotion was a cause; and in April 1905 he instigated an Admiralty circular letter calling for (N)[1] officers to serve for two years in surveying ships. A further circular in 1907 said that (N) officers who had done general service after passing out could also volunteer and would profit by valuable experience in a surveying ship. Assistant surveyors continued to be advanced in grade on recommendations for zeal and ability from officers in charge of survey. In July 1907, an Order in Council authorized the receipt of foreign surveying pay from the date of joining a ship rather than from the date of her arrival on her station, which was in line with other specialist pay. There were many volunteers from the ranks of (N) officers.

The Hydrographer submitted half-yearly recommendations for promotion to commander and captain. Learmonth was recommended on three occasions, and when Davy was recommended in December 1908, the Hydrographer took the opportunity of pointing out that there had been no promotion to commander for three years.

The introduction of surveying-recorder ratings was first proposed by Field in October 1904. He successfully resubmitted the proposals in May 1906; Treasury approval followed in January 1907. The case was made by pointing out, firstly, that a boat needed two observers, and that if one officer was released the output would be greater; and secondly, that as the conditions of exposure and long hours made the service unpopular, some inducement was necessary to encourage keenness in volunteers. There would be three recorders in the larger ships and two in the smaller, making a total of twenty-two; and extra pay at 1*s* 6*d*, 1*s*, and 6*d* per day according to proficiency was agreed. In 1908 the Hydrographer obtained approval for chief petty officers to continue as recorders without increase of complement; and later that year the drafting regulations were amended, so that on a ship paying off, recorders would be drafted to another surveying ship, not without some Board misgiving that it meant ' a closed service '.

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[1] The (N) was adopted in *The Navy List* from 1905 on a proposal from Captain Oliver, H.M.S. *Mercury*, and the (H) from 1906 when (S) was needed for signal officers.

There was another edition of *General Instructions for Hydrographic Surveyors* in 1909. The chapter on Sailing Directions had been rewritten and included an injunction that they should be compiled on conclusion of a survey and not be encumbered with too many facts that could be seen on the chart. The system of orthography was still according to Washington, accepted by the Royal Geographical Society, other departments, and the United States. There was a plate illustrating the drawing of hill contours.

A third edition of *Hydrographical Surveying* also appeared in 1909. It was undertaken at the request of the publisher, John Murray, by Field, who acknowledged the help of Purey-Cust, Moore, and Tizard, and the use of articles previously contributed by him to the first edition of *Encyclopaedia Britannica.* His preface said that material alteration of the text had been avoided as far as possible, but there were new features such as the use of photography for reducing drawings, the introduction of chronographs, the Pillsbury current-meter, the Field/Cust automatic tide-gauge, the application of rangefinders, an improved slipping-apparatus for ship sounding, and the practical effect of a better knowledge of the bottom slope at different depths when searching for vigias. There were also examples of irregular triangulation and a plate illustrating contouring for depicting hill-work.

For ship sounding the new arrangement was a jackstay from the lower boom to the sounding-davit carrying a traveller to which the slip holding the lead was attached. The slip was hauled forward by the rounding-line and tripped by a line, the length of which determined the distance along the jackstay that the lead was slipped. The slip had to be reattached to the lead after each sounding.

In 1905 the Hydrographer remarked on two ingenious devices designed by Lieutenant Craven to overcome two recurring problems—one device was a sliding scale for reducing soundings, the other an adapted station-pointer for plotting from close objects without recourse to tracing-paper. The latter problem had already been solved by the ' Cust ', the graduated xylonite plate with one side roughened to take pencil rulings, described in *Hydrographical Surveying*, 1909. According to a minute by Purey-Cust in 1910 discussing its issue to the Fleet, it had been in use in surveying ships for some twenty-five years; and, incidentally, he disclaimed any financial interest. A plane-table was issued to the *Research* in 1906.

Biographies: Afloat and ashore

CAPTAIN W. F. MAXWELL, R.N.

1872–1906

William Frederick Maxwell began surveying in 1861 in the *Porcupine* and *Shamrock* under Otter, in which vessels he was mainly engaged on surveys in the Hebrides and Ireland, where he continued until 1864, the last two years in the *Shamrock* being under Stanton. In 1865 he joined the Newfoundland survey, in which he served for some eighteen months under Kerr and was made a master.

Maxwell next served in the *Sylvia*, Brooker, later St John, in Chinese and Korean waters for four years. On his return to England in 1870, and after a few months in the department, he went back to the Newfoundland survey, where he succeeded Kerr in charge in 1872. For no less than nineteen years he continued the surveys in Newfoundland and Canadian waters using the hired vessel *Gulnare*. He was made a staff commander in 1875.

Returning to England in 1891, Maxwell succeeded Tizard in command of the *Triton*, working on the east coast of England. Two years later he was transferred to take charge of the west-coast survey in the hired vessels *Knight Errant* and, later, *Gladiator*, surveying many places in home waters until 1906. He was promoted to staff captain in 1893 and retired with the rank of captain in 1903. He died in 1908.

Maxwell's career as a surveyor was remarkable, since he was employed almost continuously on active surveying for no less than forty-five years, the last thirty-four of which he was in charge of surveys.

CAPTAIN W. TOOKER, R.N.

1891–1907

William Tooker did his first surveying as an assistant to Langdon in Bermuda in 1866, and was again an assistant in 1871, this time to Dawson on a survey of the river Plate. In 1876, as a navigating lieutenant he joined the survey of Western Australia, serving under Archdeacon and later Coghlan, the last four years in the schooner *Meda*.

Returning home in 1884, Tooker joined the west-coast survey, again under Archdeacon. He was made a staff commander at the end of 1884, but, in 1889, he declined the offer of an appointment as a naval assistant in the department. Leaving the west-coast survey in 1891, Tooker succeeded Maxwell in charge of the Newfoundland survey where he remained until 1908. He was promoted to staff captain in 1901 and retired with the rank of captain in 1906.

VICE-ADMIRAL M. H. SMYTH, C.B.E.

1891–1908

Morris Henry Smyth joined the *Fawn*, Wharton, as a sub-lieutenant in 1876 and for two years surveyed in the Mediterranean, in the Red Sea, and on the east coast of Africa, being promoted to lieutenant in 1877. In 1879 he was appointed to the *Sparrowhawk*, a schooner, surveying in the West Indies under Pullen, Carpenter, and W. S. White, successively. He remained there for nearly five years.

At the end of 1883 he went to the Marine Survey of India under Dawson and, from 1884, Carpenter. He served there until mid-1899, mainly in charge of detached boat parties; and he took part in the expedition up the Irrawaddy of 1885 during the Burma war. Returning to England in 1889 he was appointed to the *Research*, Aldrich, and worked for two years in home waters.

In 1891 Smyth took command of the *Stork*, and for three years carried out surveys on the east coast of Africa, in the Seychelles and in the Red Sea and the Mediterranean, being promoted commander in 1893. Returning home in 1894, he was employed for two years and a half as a naval assistant in the department.

Smyth next commissioned the *Egeria*, sailing from England in 1897 for British Columbia and surveying various places in South America on passage. For two seasons he surveyed in British Columbia waters and also made a sounding cruise in the north-west Pacific. He was promoted to captain in 1899, and soon after his return to England in the following year he recommissioned the *Rambler* at Malta for service on the China Station. Some work was done in the Red Sea *en route*, and Hong Kong was reached in August 1901, there following two seasons on the China coast.

In 1904 Smyth was back in England, and for the next four years commanded the *Research* on home-waters surveys, mainly in the lochs on the west coast of Scotland. He retired as a captain in 1908 attaining the rank of rear-admiral the same year and that of vice-admiral in 1914.

During the 1914-18 war, Smyth served as a captain, R.N.R., and commanded the yacht *Safa-el-Bahr* in the Mediterranean. For this service he was mentioned in dispatches and was made a C.B.E.; in addition he was awarded the Italian War Cross.

CAPTAIN F. HASLEWOOD, R.N.

1893–1909

Frank Haslewood joined the *Sylvia* in 1866 as a navigating midshipman, and surveyed for three years and a half under Brooker and St John, successively, on the coasts of China and Japan, being promoted to navigating sub-lieutenant in 1868.

In 1871 he was appointed to the survey of Victoria, Australia, under H. J. Stanley. He remained there for nearly eight years and was promoted to navigating lieutenant in 1875. A year's service with the Queensland survey under Bedwell followed, and in 1880 he was transferred to the Newfoundland survey under Maxwell for five years.

Back in England in 1885, Haslewood joined the *Triton*, Tizard, later Maxwell, working on the east coast of England until 1893. He had been promoted to staff commander at the end of 1885. In 1893 Haslewood was detached from the *Triton* to survey Plymouth Sound, and this was the inception of what came to be known as the south-coast-of-England survey, of which Haslewood had charge for the next sixteen years. The work was mainly in the dockyard ports of Plymouth and Portsmouth using hired vessels, first the *Endeavour* and then the *Sir James*.

Haslewood was promoted to staff captain in 1902 and retired with the rank of captain some four years later. He continued in charge of the south-coast survey until succeeded by May in 1909.

CAPTAIN T. H. HEMING, R.N.

1893–1905

Thomas Henry Heming joined the schooner *Lark*, Oldham, as a lieutenant in 1881, surveying for four years on the Australia Station, mainly in the Solomon Islands. This he followed by a period of just over a year in the *Flying Fish*, Maclear, working in the Eastern Archipelago and off northern Australia.

From the *Flying Fish*, Heming was transferred to the *Egeria*, Aldrich, later Oldham, and for three years and a half was principally engaged on exploratory cruises in the Pacific. Returning home in 1890, he joined the *Research*, Vereker, and spent two years surveying in home waters.

In 1893 Heming took command of the *Paluma*, surveying on the coast of Queensland, Australia, and two years later transferred to her successor the *Dart*. He was promoted to commander soon after joining the *Dart* in 1895, but a few months later was involved in a serious accident, caused by the bursting of a soda-water bottle, which resulted in the loss of the sight of his right eye. This meant his being invalided; two years later, however, he was passed fit for active service and was appointed in charge of the Marine Survey of India.

Heming was placed on the Retired List with the rank of captain in 1903, but the regulations permitted his continued employment with the Marine Survey of India where he remained until 1906. He handed over to a Royal Indian Marine officer, Beauchamp, and was consequently the last R.N. surveying officer to hold an appointment that had been in force since 1882. On leaving India, Heming became Conservator of the river Humber, where he was employed in the 1914-18 war.

C. O'N. CLARK

1868–1907

Charles O'N. Clark joined the department in December 1868 as a third-class draughtsman vice Hemming. Powell was then chief draughtsman and Bedford the Superintendent of Charts. In 1876, Clark became a second-class draughtsman, but in 1883 the committee inquiring into the department abolished the classes and established one chief draughtsman at £500 per annum and six draughtsmen at £400.

In 1900 Clark was promoted to chief draughtsman in succession to Boyle who had taken Powell's place in 1892. There were by that time twelve draughtsmen, and Stanley was in charge of Chart Branch until Pasco succeeded him in 1906. In 1905 there was a second chief draughtsman, Gibson, in recognition of the responsibilities of a branch which steadily increased its output throughout Clark's service.

In April 1907 Clark, then sixty years of age, was allowed to complete forty years' service, and he retired in December 1907, being succeeded by Briggs. He thus served throughout Wharton's twenty years and was not to achieve the new title of cartographer, which, though proposed by Field in 1905, was not approved until 1909.

THE PRINCIPAL SURVEYS OF 1904

HOME

Smyth	*Research*	Scotland, west coast	Lochs Nevis, Kishorn, and Carron
Purey-Cust	*Triton*	England, east coast	Thames estuary—Edinburgh Channel
		Scotland, west coast	Rothesay Bay, Ballachulish
Maxwell	*Gladiator*, h v.*	England, south coast	Scilly Isles
		Ireland, west coast	Youghal Harbour
		Scotland, west coast	Sound of Mull
Haslewood	*Endeavour*, h.v.	England, south coast	Plymouth and Portsmouth, Tor Bay, Brixham and Torquay

FOREIGN

Tooker	*Ellinor*, h.v.	Newfoundland	Bay of Exploits, Belle Isle Strait
Parry	*Egeria*	British Columbia	Ballinac Islands to Active Pass, Nanaimo Harbour
Learmonth	*Goldfinch*	Africa, west coast	Opobo, Brass, Nun and Bonny Rivers, and Liberian coast
		Mediterranean	Gulf of Corinth, Vurko, Dragamesti and Platea Bays
Monro	*Rambler*	China coast	Amoy
		Borneo	Labuan, Gaya and Jesselton Harbours
Hardy	*Waterwitch*	China coast	Mirs Bay, Shantung Promontory, Wangkia Bay
Pudsey Dawson	*Penguin*	New Zealand	North Island—The Bluff, Hauraki Gulf
Somerville	*Sealark*	Mediterranean	Gibraltar Bay—100-fathom line
		Red Sea	Mersa Sheikh el Barghut

BY THE MARINE SURVEY OF INDIA

Heming	*Investigator*	BAY OF BENGAL	Akyab, Arakan coast, Andaman Islands

Research also examined shoals off Dodman Point.

Triton found Shingles Patch in the Duke of Edinburgh Channel had the same least depth of nine feet but it was increasing to the north-west. The manometer, a recently invented pneumatic apparatus for tidal observations, was tested.

Gladiator was much hindered by the ocean swell in the Scilly Isles.

Egeria's survey of Active Pass was for the increasing trade between British Columbia and the orient.

Goldfinch had, in February, forty men and four officers down with malaria contracted at Opobo.

Rambler was delayed by a decreased output of coal from Labuan mines and at one time only took an inferior quality for distilling purposes.

Waterwitch was concerned with a coastal survey of the British sphere of influence on the Shantung Promontory.

Penguin lost Lieutenant Edden and five men when a steam cutter capsized and was delayed at Sydney while a new boat was built.

Sealark, newly commissioned at Portsmouth in September, also swung ship for variation at various positions in the Mediterranean and the Red Sea.

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* h.v. = hired vessel.

THE PRINCIPAL SURVEYS OF 1905

HOME

Smyth	*Research*	Scotland, west coast	Lochs Kishorn, Carron, and Dunvegan (Skye)
Purey-Cust	*Triton*	England, east coast	Thames estuary
		Orkney Islands	Westray, Hoy Sound
Maxwell	*Gladiator*, h.v.	England, west coast	Fishguard Bay
		Scotland, west coast	Sound of Mull, Tobermory
Haslewood	*Endeavour*, h.v.	England, south coast	Plymouth, Portsmouth, Tor Bay

FOREIGN

Tooker	*Ellinor*, h.v.	Newfoundland	Bay of Exploits, Belle Isle Strait
Parry	*Egeria*	British Columbia	Gabriola Pass to Porlier Pass
Learmonth, Walter	*Goldfinch*	Africa, west coast	Monrovia Bay, Cape Mount River, Kroo coast, Grand Bassa
		Mediterranean	Gibraltar Strait
Monro	*Rambler*	China coast	Hong Kong approaches
		Borneo	Labuan to Pine Point
Glennie	*Waterwitch*	China coast	Port Shelter, Swatow, Lama Islands to The Brothers
Simpson	*Penguin*	New Zealand	Hauraki Gulf
		Australia, east coast	Queensland inner route, Barrier Reef
Somerville	*Sealark*	Red Sea	Port Sudan approach
		Indian Ocean	Scientific cruise
		Ceylon	Colombo Harbour

BY THE MARINE SURVEY OF INDIA

Heming	*Investigator*	Bay of Bengal	Andaman Islands
		Red Sea	Aden Port and Bay

Triton found considerable changes in Mouse Sand and the North Knob. The manometer tide-gauge gave satisfactory results.

Egeria lost the senior assistant Lieutenant G. E. Nares, son of Sir George, who died in July, and Lieutenant Miles who joined the Canadian Government. She damaged a bilge by grounding on an uncharted reef near Thetis Island.

Goldfinch had many cases of fever, including Learmonth, and strong winds and rain made for much discomfort on the Liberian coast. Fresh provisions were obtained from the French port of Konakri. During a refit at Gibraltar, Walter succeeded Learmonth in August; and the strait was surveyed to find sites for current observations. Back on the Kroo coast, the survey was continued with floating beacons; and as already mentioned Sierra Leone was visited for health reasons.

Penguin closed the New Zealand survey in February, Simpson relieving Pudsey Dawson at Sydney. Floating beacons had to be used on the Barrier Reef off Port Douglas owing to the haze and smoke from bush-fires.

Sealark embarked Messrs Gardner and Cooper for a six-month scientific cruise, which included the Chagos Archipelago, Diego Garcia, the Seychelles and Farquhar Island.

Investigator had another but milder outbreak of beri-beri and work in the Persian Gulf was abandoned.

THE PRINCIPAL SURVEYS OF 1906

HOME

Smyth	*Research*	Scotland, west coast	Loch Snizort (Skye)
Pudsey Dawson	*Triton*	England, east coast	Thames estuary—Edinburgh Channel etc., the Medway
		Orkney Islands	Hoy Sound, Long Hope
Maxwell	*Gladiator*, h.v.	Ireland, east coast	Rosslare and Malahide
		Scotland, west coast	Sound of Mull
Haslewood	*Endeavour*, h.v.	England, south coast	Portsmouth, Plymouth
		England, east coast	Winterton to Covehithe

FOREIGN

Tooker	*Ellinor*, h.v.	Newfoundland	Bonne Bay, Belle Isle Strait
Learmonth	*Egeria*	British Columbia	Port Simpson, Chatham Sound to Dixon Entrance
Walter	*Goldfinch*	Africa, west coast	Liberian coast
Monro	*Rambler*	Borneo	Dumpil Point to Tanjong Aru
		China coast	Hong Kong New Territory
Glennie	*Waterwitch*	China coast	Swatow, Hong Kong approaches
Parry, Brandon	*Merlin*	Red Sea	Mohammed Ghul
Simpson	*Penguin*	Tasmania	Hunter group
		Australia, east coast	Queensland, Barrier Reef
Somerville	*Sealark*	Ceylon, east coast	Trincomalee
Combe		Mediterranean	Malta, Platea calibrating ranges

BY THE MARINE SURVEY OF INDIA

Beauchamp	*Investigator*	Red Sea	Aden
		Persian Gulf	Kuwait
		Bay of Bengal	Andaman Islands

Research also re-sounded spoil grounds east of the Isle of Wight.

Triton on passage south in October lost all sails and maintopmast in a cyclonic gale in which she hove to for twenty-eight hours.

Gladiator observed spring tidal streams off the Mull of Kintyre.

Endeavour lost no less than fifty-eight days through bad weather.

Goldfinch took magnetic observations at Sierra Leone, Sekondi, Brass River, Cape Lopez and São Thomé. She returned to Sheerness where she was found beyond repair and paid off after four years' surveying.

Rambler, also, was finally paid off at Hong Kong having been first commissioned as a surveying ship in 1884.

Waterwitch escaped being driven ashore in Chauan Bay in a typhoon by weighing and steaming to safety in the calm of the storm-centre as it passed over.

Merlin was commissioned at Sheerness in October by Parry who was invalided from Suez in December, Brandon taking temporary command.

Penguin measured a magnetic anomaly in Storm Bay, Tasmania.

Sealark sited beacons for a calibration range in Trincomalee for the use of H.M. ships.

The Marine Survey of India was now in charge of an R.I.M. officer, Commander W. G. Beauchamp; and the *Investigator* was a new ship, of the same name as her predecessor, built in England.

THE PRINCIPAL SURVEYS OF 1907

HOME

Smyth	*Research*	English Channel	Tidal observations
		Scotland, west coast	Lochs Ewe and Broom
Pudsey Dawson	*Triton*	England, east coast	Thames estuary—Edinburgh Channel
		Scotland, east coast	Buckie
		Orkney Islands	South Ronaldshay
Combe	*Gladiator*, h.v.	Scotland, west coast	Sound of Mull, Loch na Keal
		Ireland, east coast	Donaghadee Sound
Haslewood	*Sir James*, h.v.	England, south coast	Plymouth and Portsmouth

FOREIGN

Tooker	*Ellinor*, h.v.	Newfoundland	Cape Rich to Labrador coast, St Margaret's Bay
Learmonth	*Egeria*	British Columbia	Dixon Entrance, Masset Harbour, Virago Sound, Graham Island
Monro	*Mutine*	English Channel	Tidal observations[1]
		Ireland, south coast	Ballygeary Bay[1]
		Africa, west coast	Liberian coast
Hardy	*Fantôme*	Red Sea	Strait of Jubal
		Eastern Archipelago	Timor Sea—Ashmore Reef vicinity
		Australia, north coast	Parry Shoal, Thursday Island shoals
		Australia, east coast	Cairns to Deception Point
Glennie	*Waterwitch*	China coast	Hong Kong approaches, Swatow
Walter	*Merlin*	Red Sea	Mohammed Ghul
		Malay Peninsula	Penang and Singapore approaches
		Borneo	Marudu Bay

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[1] Carried out prior to foreign surveys.

Somerville, Davy	*Sealark*	CEYLON	East coast, Galle Harbour

BY THE MARINE SURVEY OF INDIA

Beauchamp	*Investigator*	BAY OF BENGAL	Mergui Archipelago, Andaman Islands
		INDIA, WEST COAST	Chaul beacon southwards

Research spent much time unsuccessfully measuring tides in mid-Channel positions and tried drifting a sounding boat past a moored beacon. Many magnetic observations were made.

Triton found little change in the Duke of Edinburgh Channel, and also took many magnetic observations ashore and afloat. So did *Gladiator*.

Ellinor struck an uncharted rock off Labrador and was repaired at St John's.

Egeria met the U.S. C. and G. ship *Explorer* in Alaskan waters. She made a running survey of Gardner Canal in view of a projected terminal for the Grand Trunk (Pacific) Railway at the head of Kitimat Arm.

Mutine commissioned at Chatham in May and, after work in the Scilly Isles, was more successful than *Research* with mid-Channel tidal observations.

Fantôme commissioned at Sheerness in February for the Australia Station in place of *Penguin* and did various work on passage, including magnetic observations.

Waterwitch made such observations at Amoy and Hong Kong.

Merlin did likewise at Aden, and on passage eastward searched without result for Hertha Rock off Socotra. Her ship's company was given fourteen days at Diyatalawa, Ceylon, to recruit health.

In *Sealark* Davy succeeded Somerville in October. In Ceylon, government triangulation points were used, although after twenty years they were difficult to find.

THE PRINCIPAL SURVEYS OF 1908

HOME

Simpson	*Research*	Scotland, west coast	Lochs Long and Broom, Cape Wrath
Pudsey Dawson	*Triton*	England, east coast	Thames estuary channels
		Orkney Islands	Scapa Flow, Pentland Firth
		Scotland, east coast	Granton
Somerville	*Argo*, h.v.	England, west coast	Bristol Channel—King Road
		Ireland	Rosslare, Lough Swilly
Haslewood	*Sir James*, h.v.	England, south coast	Plymouth, Portsmouth, Hamble River, Dover Harbour

FOREIGN

Combe	*Ellinor*, h.v.	Newfoundland	Notre Dame Bay, Bay of Exploits
		Canada, east coast	Gulf of St Lawrence
Parry	*Egeria*	British Columbia	Sansum Narrows, Dundas Island, Brown Passage
Monro	*Mutine*	Africa, west coast	Liberian coast
		Atlantic	100-fathom line off Spain, Ascension Island
May, Pasco	*Fantôme*	Tasmania	Norfolk Bay, the Mersey, Emu Bay
		Australia, east coast	Marion Reef, Queensland coast
Douglas	*Waterwitch*	Malay Peninsula	Klang Strait, Singapore Strait
Walter	*Merlin*	Borneo	Marudu Bay, Jesselton
Davy	*Sealark*	Ceylon, south coast	Hambantota, Egeria Patch

BY THE MARINE SURVEY OF INDIA

Beauchamp	*Investigator*	Bay of Bengal	Burma coast
		India	West coast

Research delinated new banks off Cape Wrath and North Rona where few soundings had previously been obtained.

Triton, despite strong streams, obtained good tidal observations in Pentland Firth using a pneumatic apparatus.

Argo was a hired steam yacht. She had boiler-trouble when examining an area fifty-five miles north-west of Lough Swilly and was put under sail until towed to safety by the Canadian Pacific Railway Company steamer *Monmouth.*

Ellinor sounded across the Gulf of St Lawrence abreast Cape Rich, and delineated many shallow banks.

Egeria examined many reported dangers including Celestial Reef, and found a very dangerous rock in Brown Passage approach. She took a large number of tidal, current, and magnetic observations.

Mutine, as described, went to Ascension Island for a redetermination of the longitude of the Cape Observatory. On passage to and from refits at Plymouth she delineated the 100-fathom line off Spain.

In *Fantôme*, Pasco succeeded Acting Commander May in June at Sydney. The work at Norfolk Bay included the triangulation of a calibrating range required by the Commander-in-Chief.

Waterwitch located Scawfell Shoal with five fathoms on it between Saigon and Singapore.

Merlin bottled some surface-water and gas on Gordon Patch, thirteen miles from Labuan Island, which, with some mud from sixty-two fathoms, was sent home for analysis. There was a very distinct smell of petroleum and the area of bubbles was clearly defined. On passage to Hong Kong, magnetic observations were made at Manila.

THE PRINCIPAL SURVEYS OF 1909

HOME

Simpson	*Research*	Scotland, west coast	Troon, Brodrick Bay, Arran, Lochs Inchard and Laxford
Pudsey Dawson	*Triton*	England, east coast	Thames estuary, the Medway, off the Norfolk coast
		Scotland, north coast	Pentland Firth
Somerville	*Argo*, h.v.	Ireland	Lough Swilly, Bantry Bay
		Scotland, west coast	Outer Hebrides, St Kilda
Haslewood, May	*Sir James*, h.v.	England, south coast	Plymouth, Portsmouth, Dover Harbour

FOREIGN

Combe	*Ellinor*, h.v.	Newfoundland, west coast	Bonne Bay to Great Mekattina
		Newfoundland, east coast	Farmer Arm
Parry	*Egeria*	British Columbia	Edye, Beaver, and Schooner Passages, Hecate Strait
Monro, Hardy	*Mutine*	Africa, west coast	Liberian coast
		Ireland, east coast	Rosslare Bay (see p. 242)
		Atlantic	Ascension Island, deep-sea soundings
Pasco	*Fantôme*	Australia, north coast	Cartier Island, King Sound
Douglas	*Waterwitch*	Malay Peninsula	North Klang Strait, Singapore Roads
Learmonth	*Merlin*	Borneo	Ambong Bay, Cowrie Bay to Grassy Point
Davy	*Sealark*	Ceylon	South coast
		Malay Peninsula	Trang River entrance

BY THE MARINE SURVEY OF INDIA

Beauchamp	*Investigator*	BURMA INDIA	Coastal surveys West coast

Research also sounded west of the Hebrides and took many tidal-stream observations including Southampton Water and Falmouth. In October she was diverted to search for a reported shoal eastward of Smiths Knoll, but bad weather intervened.

Triton obtained successful tidal observations with a pneumatic apparatus in the English Channel and found that the Field/Cust apparatus needed only slight improvements.

Argo spent June to September sounding 5 000 square miles west of the Outer Hebrides. The south-coast-of-England survey was taken over by May in July.

Egeria's work was in very exposed waters. A number of dangers was found in the various passages and the increase in the size and number of ships using them was most noticeable.

Mutine took deep-sea soundings to delineate the 100-fathom line off Portugal on her passages between England and the east coast of Africa. While refitting at Plymouth, a party was sent to examine the rock off the Ore Stone in Tor Bay, which H.M.S. *Hannibal* had touched.

Fantôme, after refit at Hobart, sailed for the north coast of Australia via Thursday Island. Her survey and annexation of Cartier Island has already been mentioned. She returned to Hobart via Fremantle.

Waterwitch triangulated Malacca Strait from Cape Rachado to Singapore, being greatly assisted by the Johore Government, who provided parties for clearing wooded hill-tops.

Merlin, as earlier described, joined in the hunt for a pirate in Borneo waters, reminiscent of Belcher's activities many years previously.

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Admiral Sir H. E. Purey-Cust, K.B.E., C.B.

HYDROGRAPHER 1909–1914

AFLOAT

Simpson, Pudsey Dawson, Monro, Pasco,
Walter, Davy, Penfold, Peebles

ASHORE

Briggs

Herbert Edward Purey-Cust was born in 1857, the son of the Dean of York and Lady Emma, daughter of the Earl of Darnley. He entered the Navy as a cadet in 1870 and was promoted to midshipman in 1872, to sub-lieutenant in 1876, and to lieutenant in 1878. He began surveying in 1881 when he joined the *Fawn*, Aldrich, spending two years in the Red Sea and on the east coast of Africa. In 1884 he joined the *Rambler* and served for four years and a half on the China Station, the first year under Vereker and the remainder under Moore. In 1889 he joined the *Egeria*, Oldham, in the Pacific, and from 1890, when Field succeeded Oldham, in North Borneo and the Anambas Islands. He was first lieutenant to Field.

Early in 1892 Purey-Cust obtained his first command, the *Dart* on the Australia Station, and for nearly three years and a half he surveyed in the New Hebrides and on the Tasman Peninsula, being promoted to commander in 1894. When working off the volcanic island of Ambrym, New Hebrides, in 1894, a violent eruption took place and a stream of molten lava entered the sea close to the *Dart*. Steam and dust stopped surveying operations and assistance was rendered to the islanders; at the same time observations of various interesting phenomena were recorded.

Returning home in 1895, Purey-Cust came to the department as a naval assistant until he succeeded Richards at the end of 1897 in command of *Rambler*. In this ship he had a roving commission; his surveys, ranging from the West Indies and the Strait of Belle Isle to the west and east coasts of Africa and the Red Sea, ended, in 1901, at Malta. In 1900 he was promoted to captain, Wharton having said in his recommendation that he had ' shown his talent by devising various contrivances for expediting and improving surveying operations '—talent that was shown in the development of the Field/Cust automatic tide-gauge and of the transparent station-pointer, still in use.

From 1902 to 1905, Purey-Cust commanded the *Triton*, surveying on the east coast of England, including the Thames estuary channels and tidal observations in the North Sea. He also joined in the surveys of the west Scottish lochs, and in his last year he began the important work in the Orkney Islands that was to be so much used by the Fleet in the 1914–18 war. In March 1906, he was sent to Bantry Bay, Ireland, where he was engaged for two months in surveying the calibration range required by the Fleet.

In April 1907 he was appointed Assistant Hydrographer and two years later, on 16 August 1909, he succeeded Field. During his five-year tenure, Purey-Cust initiated the Hydrographer's annual visits of inspection to surveying ships in home waters, and he was much concerned in preparations for the war, which broke out about a month before he handed over to J. F. Parry on 31 August 1914. He had been promoted rear-admiral in 1910 and awarded the C.B. in 1911.

Throughout the war he served as a commodore second-class, R.N.R., and commanded the fleet auxiliary *Zaria*. He was made a vice-admiral on the Retired List in 1915 and admiral in 1919, in which year he received the K.B.E. He died at Highgate aged eighty-one on the 11 November 1938.

The contemporary scene

During Purey-Cust's period there occurred a progressive deterioration in Britain's relations with Germany, and, as remarked, when he handed over to Parry the 1914–18 war had already begun. In 1911 another German objection to French activity in Morocco was supported by the dispatch of the gunboat *Panther* to Agadir. This led to a crisis and a warning to Germany in a speech made at the Mansion House by Lloyd George, with the approval of Lord Grey, Foreign Secretary. The threat of war passed, but not without some French concessions to Germany in West Africa. Germany exhibited a lack of interest in the proposal for a ' naval holiday ', made by Churchill after he had succeeded McKenna as First Lord in 1911. The Anglo-French naval agreement enabled the British Fleet to reduce its strength in the Mediterranean and thus to concentrate in the North Sea. The Naval Staff expanded, and the Hydrographer was increasingly committed with heavier chart issues to the larger Fleet and its auxiliaries, with many more questions on harbours, including their mooring plans, such as for destroyers at Harwich, and their defences, and, afloat, with surveys of the North Sea banks, of the firths and lochs of Scotland and anchorages in the Orkneys and Shetlands.

In 1912 in the Balkans, a successful military alliance of Greece, Serbia, and Bulgaria reduced Turkey's territory in Europe almost to the shores of the Dardanelles, while Italy had taken Tripoli from her in the previous year. The alliance broke down in 1913 and Turkey retook Adrianople. The subsequent uneasiness soon saw Austria's accusation of Serbia on the assassination of the Archduke Ferdinand at Sarajevo in June 1914 and her bombardment of Belgrade in July. Russia was not to be deterred as she had been in 1908 by German military strength when the latter supported Austria, and she mobilized for war. Thereupon Germany declared war on Russia and her ally France and demanded of Belgium a free passage for her armies. This threatened Britain's age-old policy of not allowing a hostile Power to occupy the Low Countries, and on 3 August Britain dispatched an ultimatum to Germany. It remained unanswered, and Britain and Germany were at war from 4 August 1914—the First World War had begun.

At home, there was the accession of George V in 1910, and a review at Spithead the following year. There were the rail and coal strikes of 1911 and 1912, the suffragette activity of 1912–13, and grave disturbance in Ireland. Such troubles were forgotten on the outbreak of war, for which the Fleet was ready after a test mobilization and an assembly at Spithead in the preceding July.

The Union of South Africa came into being in 1910. There was the *Titanic*'s disastrous collision with an iceberg in the Atlantic in 1912. In 1913 the first vessel passed through the Panama Canal, which was opened the following year.

Exploration of Antarctica continued. There were the French expedition of Charcot in the *Pourquoi-Pas* in 1908–10, the German under Filchner in the *Deutschland*, and the Norwegian under Amundsen in the *Fram* in 1910–12, during which Amundsen reached the South Pole on 14 December 1911. The British Antarctic Expedition set out in 1910 under Scott in the *Terra Nova*, which reached the South Pole on 18 January 1912, but five of the party, including Scott, perished on the return journey. As on former occasions, equipment was loaned by the Admiralty, and the department received various items of hydrographic information from the expedition. There was the first Japanese expedition of 1911–12 and the Australian under Mawson in the *Aurora* in 1911–14. Lastly, in 1914, the British Imperial Trans-Antarctic Expedition sailed under Shackleton in the *Endurance*. The Hydrographer advised the Board on awards of the Polar Medal.

Departmental activity

A month before Purey-Cust assumed office, a Board meeting, which took up Field's request for staff in February 1909,[1] decided on a reorganization of the department into two sections—one hydrographic and the other navigational. The plan drawn up was based on the recommendations of the 1905 committee for the appointment of (N) officers to certain branches, and it introduced an Assistant Hydrographer (N) in lieu of the Superintendent of Sailing Directions. In approving it the First Sea Lord, Fisher, was largely concerned with the duration of officers' appointments: he said that the Hydrographer's appointment should be no longer than five years in order not to debar the appointment to others, and he considered that one flag-officer in the surveying service was a fair percentage; there should not be too many retired officers among the assistants; and the Hydrographer should continue ultimately to be responsible, and the senior of the two Assistants should sign for him.

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[1] See p. 219.

Purey-Cust, given the opportunity to comment, strongly favoured two separate departments and also objected to the reduction of the post of Superintendent of Sailing Directions. The Board, however, went to the Treasury in October 1909, showing that relief to the Hydrographer on navigational matters was essential, that existing practice was not being disturbed, and that the financial cost would be the difference in the salaries of the Superintendent of Sailing Directions at £800 and Assistant Hydrographer at £950, noting, as the First Sea Lord had directed, that the increase covered the appointment of a captain in place of one whose last active rank was staff captain. In November the Treasury, adverting to the improvements made as a result of the 1905 committee's report, remarked that sales receipts had fallen [from £27 000 in 1907 to £25 000 in 1910] and rejected the Admiralty proposal. So, an unfortunate situation arose whereby Captain F. S. Miller, who had been appointed temporarily in August, was Assistant Hydrographer (N) at £950, and Monro, who had been Purey-Cust's nomination in place of himself pending Parry's return from British Columbia, was at first the Superintendent of Sailing Directions vice Langdon who was retired, at £800. He continued at this salary when made Assistant Hydrographer (H) in December. Parry arrived to succeed Monro in April 1910, and C. V. Smith, assistant in Sailing Directions Branch, had necessarily taken the superintendent's responsibility from October 1909.

Meanwhile, after the Treasury's decision of November 1909, Purey-Cust said that one could not help regarding the net result as a most unmerited reflection on the department and the hydrographic service generally. He continued: 'It surely cannot be Their Lordships' belief that hydrography has ceased to be important to the Fleet. Never in the history of the department was there a more inopportune time to make such an experiment . . . in conclusion I must point out that, if the proposed changes are to be maintained, I consider it will be impossible for myself or any other officer to maintain the efficiency of the department.' A year later, October 1910, he reported that the changes had not achieved the desired effect; the pressure on the Hydrographer had not been relieved, since he still had ultimate responsibility, harmony having been maintained only through the personalities of two able

Assistant Hydrographers. Both sections were at a disadvantage, and both needed more assistance. ‘ Some day ’, he said, ‘ a mistake may lose a battleship or worse and will it then be sufficient excuse that Hydrographer has been occupied with other duties? ’ He protested against the number of staff or their salaries being in any way dependent on sales, since the department primarily served the Fleet and should be judged, like others, by its efficiency in meeting requirements, though the department was unique in contributing to the Exchequer.

Thus, Purey-Cust again proposed two separate departments, and attached drafts of the instructions that might be issued to the Hydrographer and Director of Navigation, showing also what work[1] and what staff should be transferred from (H) to (N). In a separate minute to the First Sea Lord he said that if his proposal ‘ diminished the apparent importance of the Hydrographer's office, this is a minor matter if the efficiency of the service generally requires it and would suffer in any case provided no such change took place ’. He said that a Hydrographer's experience of navigation could not outweigh a loss on the (H) side, and the (N) side now needed someone who was up to date on general-service matters, in which surveyors' experience was no longer what it was, adding that any suggestion that surveyors should do alternate commissions in general service was impracticable. He continued, ‘ If Hydrographer's post was vacant tomorrow it is conceivable with a choice of two evils, the new one would be from the general service as apparently the lesser evil ’, and this would be disastrous to the surveying service as well as being little to the taste of the officer selected. Moreover, it was never more necessary to attract volunteers and maintain the surveying service at full strength.

In July 1911, the Board did not agree to a separate (N) department, but in response to various detailed requests for additional assistance decreed the appointment of a second-division clerk in Issues Branch, one naval assistant (N) to assist the Assistant Hydrographer (N), and three hired clerks. However, the first was in lieu of a naval assistant (it was ordained that the succession of the other naval assistant in Issues Branch by a clerk should be considered) and the second required the reduction of a naval assistant (H). Purey-Cust had accordingly to object again to this reduction in his staff, drawing attention to some new work such as distance tables, Tide Table reorganization, tidal-stream revision, and so on. Then, in October 1911, the Board reconsidered their previous decisions to this extent: the second Assistant Hydrographer was to receive £950, the Sailing Directions assistant was to become a superintendent, with allowance increased to £100, the Chief Civil Assistant's salary was to increase by £50 to £700 and a naval assistant (H) was added for three years, although the need for annual revisions of Light Lists should be checked with other hydrographic offices. There was to be no increase in Chart Branch, and no post of Civil Assistant, though by 1912 the Hydrographer succeeded in having Llewellyn made a staff clerk. Lastly, there was a decision on the transfer of Compass Branch, which will be described later. Neither Parry, as Assistant Hydrographer (H) from April 1910, nor C. V. Smith as Superintendent of Sailing Directions, in effect from October 1909, were allowed by the Treasury to back-date the adjustments of salary.

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[1] A list of the items shows how the department's work had increased not only by the sheer weight of number of units now in the Fleet. Subjects included: the Navigation School, defence navigation, compasses, chronometers, meteorology, pilotage, groundings and collisions, jurisdiction and moorings at Admiralty harbours, navigational equipment, Fleet programmes, fisheries' damage-claims. The staff transfers would have left the Hydrographer with a staff of fifty-nine, the Director of Navigation with seven, and the Superintendent of Compasses with four.

The navigational part of the department's work steadily increased. In 1910 there was a new issue to the Fleet—*Half-Yearly Report on Navigational Subjects*—compiled in cooperation with the Navigation School. In July 1913 it became *Yearly Summary on Subjects connected with the Navigation of H.M. Ships.* In 1914 the Douglas protractor and parallel ruler was issued to the Fleet in chart sets, replacing the semicircular protractor. It had undergone previous trials, and, as the Hydrographer said, its utility became increasingly apparent to naval and civilian officers in the department. Douglas took out a design registration in 1913.

Cust's 10½-by-7-inch station-pointers of xylonite, with one surface roughened to take pencil markings, were supplied to the Fleet in 1911. There were continuing trials of various patent recording logs and speed-indicators such as the Forbes, Neptune, and Trident. The Kelvin & White motor sounding-machine became established, in conjunction with chemical glass tubes. Stuart's marine distance-meter was a new supply in 1912, and an artificial-horizon instrument by Elliott gave an error of ±2 minutes on trial—the Battenberg course-indicator and Grant's manoeuvring-board were standard supplies. In some harbours, dolphins proved preferable to mooring-buoys.

In April 1913 Purey-Cust again represented, this time successfully, that there should be a separate navigation department. Instructions from the Board were issued in November to the Director of Navigation, Nelson-Ward, as head of a department under a Superintending Lord. All the subjects listed in the footnote opposite were included, with the exception of chronometer supplies. The necessary alterations to the Instructions for the Hydrographer, included, at Purey-Cust's suggestion in August, specific mention of his responsibility for the issue of Notices to Mariners, for the supervision of printing, engraving, and sales, and for the sufficiency of stocks of Sailing Directions, *The Nautical Almanac*, and chronometers.

This arrangement did not last, however, and in 1916 the Navigation Department again became a branch of the Hydrographic Department. The Hydrographer, then Parry, was at pains to increase the Director of Navigation's responsibilities; in February 1919, therefore, although he advised and assisted the Hydrographer, a detailed list was drawn up of navigational subjects for which he was responsible to the Board. To this list, seamanship was added in March. It is worth recording that plotting was added in 1933, and that in

1945 the branch was once more separated to become a division of the Naval Staff.

An important additional source of information and of interest was the report of the committee appointed by the Lords Commissioners of the Admiralty in January 1912 to inquire into the question of reorganizing Admiralty charts. This arose from a minute by the Hydrographer in October 1910 in which he said that his attention had been directed for some time past to the enormous labour of correctional work being thrown on (N) officers in the Fleet, and there were strong arguments for an inquiry, with navigating officers of the Fleet and a Merchant Navy officer on a committee. Parry was appointed chairman, and its members were Captain D'Arcy (succeeded by Reeves), Douglas, and Captain T. S. Angus of the P & O Steam Navigation Company, with Barber as secretary.

The committee's terms of reference after some discussion were agreed as charts that could be dispensed with, standard scales to be adopted, rescheming of charts, rearrangement of chart sets and folios, and relief to the navigators' growing labour of chart correction. The needs of the Fleet were to be the first consideration but the wants of the mercantile marine were to be met as far as possible. The report was dated June 1913.[1] It had a historical preamble, concluding with the comment that the net profit from sales in 1912 at £30 000 more than paid the cost of the departmental staff at £18 996, ' the whole of whom would have to be maintained if their labours were limited solely to the production and supply of charts for requirements of the Navy '. The net value of 411 394 charts for the Navy was £53 500.

After describing the work of production under cartographic compilation and engraving, the latter requiring four to five months at a cost of £60 in labour for a DE chart, the report mentioned the constant corrections, which created difficulties in keeping abreast of the work, dictated the use of copper plates, and involved much manuscript correctional work on stocks in the office, at the agent's, and in depots. It found the lack of staff most evident, and after emphasizing the length of a cartographer's period of training, it said:

> Considering how important the chart is to the safety of ships, it is surprising that with the great growth of the Navy, irrespective of the merchant marine, a more serious attempt has not been made before now to provide an adequate staff to permit of publication, with the least possible delay, of all valuable information available.

In the same vein, the last paragraph of the report read:

> In conclusion, although our recommendations involve additional expenditure, in our opinion such expenditure is fully warranted in the supreme interests of H.M. Navy. Whilst expenditure without stint is incurred to produce the highest and most efficient types of vessels and the best weapons and appliances for their use, it would be illogical and false economy to withhold

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[1] Appendix C, 4 (Misc. 52).

> the necessary funds to enable the charts and Sailing Directions to be placed on the same high level of efficiency.

The committee found little difficulty in recommending a classification of charts under six headings, given in an appendix to the report, viz. small-scale coast charts on 1/500 000, through port-approach charts on 1/50 000, to closed-harbour charts on 1/10 000. The adoption of such a system would lead to uniformity in the future, and though it would save time to follow foreign scales, many countries had but recently begun publication with the result that they had benefited from the experience of others and used scales conforming to those now proposed.

On the question of dispensing with certain charts, the committee pointed out that many had been made from surveys under sail and some for scientific purposes, while others covered nearly identical areas, probably for sufficiently good reason at the time. Every chart not actually required meant an unnecessary burden of correction. Their examination of every chart was a heavy but useful task, and an appendix to the report discussed some 900 charts, showing that 78 could be cancelled at once and 315 cancelled after portions of them had been transferred to others. Of the charts on ½DE sheets, 213 could be reduced to 106 on DE sheets. The straightforward cancellations were reported at once to the Hydrographer for action, but unfortunately, the committee said, the other work was impossible with existing staff, despite the immediate relief that would accrue in other fields. One recommendation was, therefore, that the cartographic staff should work overtime for two years, at a cost of £600 per annum, with an increase of engraving costs by £6 000 and electrotyping by £1 500, both over two years.

Lastly, under this heading, the committee proposed the transfer to the Canadian Government of fifty-six charts of the lakes, surveys for which had been at Canadian expense. There was, however, the proviso that the Admiralty should be supplied with impressions should the lakes become open to deep-sea navigation.

As for rescheming, it would be impracticable on a world-wide basis with the present arrears of work and with the impossibility of rapidly adding trained staff or engravers, and the committee could do no more than indicate the lines on which the work should proceed. Home waters should, however, receive special attention. Little consideration had been paid to the matter in the past, and many coast sheets did not join. Sizes varied from antiquarian to demy, and it was desirable in future to have no smaller size than DE with a maximum extension in length to 56 inches, using two folds. For convenience of handling, there should be no larger sizes, and slip-plates should be abolished. In view of the concentration of the Fleet in home waters a special effort should be made here. It was noted that the Germans had charts of comparatively recent origin containing more up-to-date ordnance topography than those of the Admiralty. This recommendation involved another chief-cartographer post at £500–£600, two cartographers transferred from other work, and eight draughtsmen at £876 per annum, four of whom would replace the two cartographers in accordance with the recent decision to allow two draughtsmen for each cartographer reduced from the establishment. Engraving costs would be £2 000 per annum, and the programme covered three or four hundred charts over a ten-year period. Officers of Chart Branch would, meanwhile, draft schemes on similar lines for the rest of the world.

Chart folios and sets were studied in detail by Captain D'Arcy. One hundred and nine folios were redesigned geographically in consultation with the Hydrographer and rearranged into sets. There were thirty-four general sets, three for passages, eleven for local use, and four for submarines. There were special sets for destroyers, auxiliaries, and trawlers. This would ease the burden of Chart Issues Branch, which shouldered a heavy responsibility for ensuring the correction of charts and the replacement of those cancelled. As an example, a new chart of The Downs had previously required a printing-run of 1 100 for all sets afloat and in store. The rearrangement was taken in hand while the committee was sitting.

Finally, the relief that could be provided to the navigator afloat was considered to be best met by the addition of a chief quartermaster to assist in the labour of correction. It was pointed out that ships now carried 1 500 charts, in comparison with the previous figure of 750, and that the policy of ensuring readiness of a ship to proceed to any part in which she would have to operate in war, perhaps under wireless orders, did not permit the suggestion, made by many of the (N) officers consulted, that more folios should be on deposit in depots. It was shown that the Block Notices to Mariners had been helpful in avoiding new editions from foreign information, but they had added to the correctional work.

Similarly, the importance of correct Sailing Directions was emphasized. They, fifty-nine in all, were being republished every ten years, supplements were put out every three years, and there were also annual summaries of Notices, which had been begun in 1907. It was now recommended that there should be a supplement at the beginning of each year which cancelled its predecessor. This meant adding two naval assistants to the staff at £1 060 per annum, since the annual supplements could not be done by outside revisers.

The long-term proposals of the committee were overtaken by the outbreak of the 1914–18 war, but in December 1913, six months after it had reported, the Hydrographer represented his requirements for additional staff to the First Sea Lord. They were two naval assistants for tidal work and two for Sailing Directions, two assistant clerks for Chart Issues Branch, and one staff clerk for the secretariat. There is no evidence that the recommendations of the 1913 committee regarding Sailing Directions were ever implemented. Some volumes had an annual supplement for a few years, but the average interval between issues was from one and a half to two years for several decades.

There was a major change in the preparation of Tide Tables, which was not achieved without difficulty and repeated arguments on their importance. It began with the Hydrographer's proposals in October 1913 and concluded with a Board letter of July 1914 which gave the Treasury ruling whereupon the Surveying Officer for Special Business became the officer ' in charge of Tidal Work '.

The Hydrographer showed how there were predictions for twenty-seven standard ports in U.K. and for twenty-nine colonial and foreign ports, the latter being respectively supplied free or by exchange with Governments. Predictions for U.K. ports had always been based on tables prepared by Sir John Lubbock some eighty years previously. They were known to be inaccurate, and in 1912, on his appointment as the Surveying Officer for Special Business, Warburg was encouraged to study tidal phenomena and prediction. He had shown great aptitude, and his methods, worked up almost entirely out of office hours, were as good as, if not better and also cheaper than, methods of harmonic analysis using the predicting machines of Mr Roberts or those at the National Physical Laboratory. Machines were, however, necessary when, unlike in U.K. waters, there were appreciable diurnal tides. It was, moreover, preferable for the department to have control over work for which it had to accept responsibility.

Stanley, who had done computations since leaving the department in 1906, had recently died, and, as there was no competent retired officer available, the Hydrographer now proposed that computations should be done in the department. He asked for an additional naval assistant and a computer. The former was to take over instrument supplies and to understudy Warburg, and Gibson was appointed on a temporary basis in May 1914. On the question of a computer, the Hydrographer considered a highly-paid ' established computer ' unnecessary, but he required continuity. Eventually, in January 1914, Timbury, a temporary computer at the Royal Observatory, was transferred to the Hydrographic Department in the grade of hired extra clerk.

The Hydrographer's initial submission concluded with an appeal that Warburg should be encouraged to continue his work, ' in view of the fact that with the death of the late Sir George Darwin, no practical authority in this little-understood scientific subject exists '. He asked for a £100-per-annum allowance, and then had to give the Treasury more details in which he quoted theoretical errors in Lubbock's method as an hour in time and two feet in height at Sheerness. The Treasury's solution to Warburg's remuneration in June 1914 was £100 on completion of every four ports to be predicted, involving five such payments in all; and there was to be an annual progress report. However, there was also an immediate payment of £100 for past work. Thus, the first step in constituting a tidal branch was taken.[1]

At the end of the Purey-Cust period there were, besides the Assistant Hydrographer and the Superintendents of Chart Branch and Sailing Directions, eight naval assistants. Douglas succeeded Glennie as the Superintendent of Charts in 1910 after the post had been vacant for three months and despite the fact that he was not promoted to commander until the end of the year. Harris joined Chart Branch as a naval assistant, at first temporary, in 1910, and was to continue in the post for more than a quarter of a century.

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[1] File H.D. 1015/1913—Appendix C, 7.

Cartographers were gradually recruited to fill posts authorized in 1909. Notably, Stigant, Buck, and Richmond joined in 1910, followed by Hayes and Mead in 1911. Codd, who had been Curator from 1909, joined Gibson and Underhill as a chief cartographer when Briggs retired in 1911. In June 1912 a new arrangement for cartographers and draughtsmen was introduced. The Hydrographic Department's file is missing, but the 1913 committee referred to the reduction in the number of cartographers, and to the fact that two draughtsmen were being entered to replace each outgoing cartographer. It may be inferred that there were two reasons: one, the difficulty of attracting suitably qualified cartographers; the other, the saving in expenditure on salaries.

At the end of the period there were three chief cartographers and seventeen cartographers assisted by eleven draughtsmen, Chart Branch having been divided into two sections in 1910. Overtime was authorized within Chart Branch, and the results of its working reported, e.g. in July 1914. In order to speed up its work, Purey-Cust, in 1911, discussed with the Director of Naval Intelligence the possibility of obtaining, through naval attachés, prior information of the surveying and charting programmes of other countries. The first suggestion was that the Admiralty should lead the way with a promulgation of its programme and hope for reciprocity, but it was soon decided that official divulgence of such details was unlikely. Instead, it was arranged through the Foreign Office that British consuls should endeavour to obtain such information for inclusion in their annual reports; and some details were soon obtained in this way.

The number of charts in the catalogue fell to 3 591 in 1913 following the recommendations of the committee report of that year; and it had reached a peak figure of some 3 650 by about 1910. The annual number of new charts during the period was between forty and sixty, with some 300 new editions, as well as around forty charts improved with the addition of new plans. Notices to Mariners for the first time exceeded 2 000 in 1913, in which year the recorded figures for corrections to plates were 815 large, which did not, however, involve cancellations, and 9 309 small; and manuscript corrections to stocks were 169 064. The ' small corrections ' were now so styled at the bottom left-hand corner of the plate. Chart printings exceeded a million—1 303 377—in 1914, of which about two-thirds was for naval or governmental use, and sales realized £45 170. The annual report for 1913, the last one to be presented to Parliament, also listed the new charts, new editions, and so on, and it was in some other ways redesigned.

The tables used in the construction of charts were collected and published in book form in 1913 for use in Chart Branch and by surveyors afloat. The earlier contributions had been by Powell and Carrington between 1856 and 1882 and the later ones in 1910 by the cartographer, J. W. Atherton, who, for that on great-circle sailing, collaborated with J. T. Towson, examiner to the Mercantile Marine Board at Liverpool. A table of chords was originally prepared by Tizard and revised by Douglas in 1913.

There was a proposal in 1911 to alter the Coal and Telegraph chart to one showing coal and oil facilities, but it was discarded on strategic grounds. In 1912, special charts of the German coasts using the latest German ordnance-survey maps were produced for operational purposes, and the issue of confidential information to the Fleet by charts and notices increased. In 1912 Douglas designed experimental air maps on xylonite.

There was a new edition in 1910 of 'Signs and Abbreviations used on Admiralty Charts' on a ½DE sheet. Small circles were again used in the base of symbols for floating navigational marks to indicate their exact positions, but the major change in cartographic styles was the adoption in 1911 of a new compass rose. It had an exterior true circle in degrees and an interior magnetic circle with both points and degrees together with the amount of variation and its annual change. A Notice to Mariners at the beginning of 1914 announced the introduction of true bearings in all Admiralty publications. True bearings only were to be used in Sailing Directions and Light Lists, the latter emphasizing that all bearings were given true from seaward; but Notices continued to give both true and magnetic.

Distance tables for naval stations were produced from 1909 on the receipt of a set of tables for the Mediterranean compiled by Commander J. E. T. Harper. The weekly Notice to Mariners issue was compiled in 1911 into eight sections, one of which listed the new charts and new editions. The proper correction of charts in H.M. ships was one purpose of a Register of Hydrographic Documents introduced in 1909 but it was replaced by a simpler Record in 1914, these changes being included in *King's Regulations and Admiralty Instructions*. The life of all chart folios was set at four years in 1913. There was a revision of the Hydrographic Note in 1910.

In Chart Issues Branch, a card-index system was adopted towards the end of 1911. By February 1912, a second-division clerk, May, had replaced the remaining naval assistant, and Llewellyn was put in charge of the branch as a staff clerk. Early in 1914, the supply of charts and books to naval air stations was organized, and two temporary clerks were added to the branch in August. At the end of the Purey-Cust period, the civilian staff under the Chief Civil Assistant, Barber, numbered fifteen. Departmental accommodation was mainly on the second floor of North Block, with some staff on the third floor and some in the old building, while the original documents were in the sub-basement. This scattering of the staff led to increases in messenger staff from time to time and to the Hydrographer's voicing, in April 1912, the desirability of moving the department into a separate building.

In the chart depots, the stocks steadily increased, there being additional commitments such as for colliers in war as for other fleet auxiliaries. Staff were reviewed, and 1910 saw the establishment of the two grades—assistant and attendant. There were then 40 000 charts at Sheerness, 46 000 at Plymouth and 49 000 at Portsmouth, and the first appointments of assistants to these depots were, respectively, Hollway, Bushby, and Bunney, at salaries of thirty shillings to forty shillings by one shilling annually but shortly increased to forty-two shillings to fifty-seven shillings by two shillings annually. Lieutenants or commanders were in charge of the chart-and-chronometer depots and had two assistants and four attendants. Two additional staff were allowed in 1912 to Sheerness and Portsmouth, where the swinging of ships was also undertaken. Accommodation was available for a depot at Rosyth in January 1914. New instructions to officers in charge of depots were issued in June 1912.

Foreign chart-and-chronometer depots were reorganized in 1913 to bring them into line, the new staffs being approved in June. They were then: Gibraltar, 14 000 charts, one assistant and one attendant; Malta, 17 000 charts, one assistant and two attendants; Cape of Good Hope, 6 000 charts, one assistant; Hong Kong, 14 000 charts, one assistant and one attendant. The assistants were given colonial and house allowances at local rates and were to be draughtsmen competent to correct charts after training in England, except that at Malta a suitable Maltese was available. The attendants were to be local men, and after discussion it was agreed in principle that their duties were such that they should not include office-cleaning. The Sydney depot was about to be closed, and at Bermuda the stock was so small that the provision of £50 per annum for occasional assistance sufficed. Hollway and Bunney were among the first to go abroad.

A new agreement with Malby for chart printing was signed in April 1913 after protracted discussion, conducted at first in collaboration with H.M.S.O.[1] The matter was originally raised by the Hydrographer in 1911 after complaints of ‘ sweating ’, whereupon he proposed the inclusion of a fair-wages clause and the appointment of an Admiralty representative at Malby’s. It was, incidentally, shown that at that time Malby was employing four draughtsmen on manuscript corrections after printing.

Further consideration was deferred until May 1912 when the Hydrographer was able to report the successful production of a cloth-backed paper on which charts for the Fleet could be printed. The cost of the new mounted paper, to be borne by the Admiralty, would be balanced by the saving on hand mounting after printing.[2] It was agreed that it was impracticable to go out to tender for chart printing, largely because other firms did not handle such large sizes. It was also desirable not to discourage the three firms, Malby, Weller, and Davies, since they were employed on engraving, which was so important in chart work and which was in danger of becoming ' a lost art '.

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[1] File H.D. 437/1913.

[2] During the 1914–18 war, unmounted charts were supplied in large numbers to the mercantile marine, and in 1922 their issue to the Fleet was commenced. Economy instigated the change, but it could be said that much-used charts had short lives owing to frequent cancellations, and that the greater number were printed by photolithography, in which there was practically no distortion.

Of various points at issue, one was Malby's objection to the limiting of copperplate printing to 50 instead of the former 200 copies, and it was eventually agreed to accept that the minimum number of copies for printing by lithography (zinc as well as stone was in use) should be 100 rather than 200. The firm accepted an Admiralty representative in 1912, so that an additional second-division clerk was allowed to the department, but it concurrently refused to negotiate any further with H.M.S.O., so the Hydrographer finalized details of the new contract. This included a new schedule of prices, though it showed little change, on account of the considerable reduction negotiated a few years earlier. At the same time, steps were taken to confirm the semi-official arrangement whereby the Ordnance Survey would print charts in the event of a stoppage at Malby's.

As soon as the new agreement was signed, an inquiry was begun by the Hydrographer into future arrangements, as he had been directed by the Financial Secretary. It was delayed by the committee's preoccupation with reorganizing Admiralty charts, but in October 1913 a comprehensive report went forward over the signatures of Douglas, Barber, and another.[1] Its conclusions were: that the provision beforehand of an emergency service would involve a breach of contract with Malby—this could, however, be done when the contract ended in April 1916, but dividing the work between two firms would be costly and unsatisfactory; that nothing would be gained by going out to competitive tender; that the Ordnance Survey, which was visited, would be too pressed to undertake all the Admiralty work, itself greater in war, and there would be a lack of Admiralty control; and finally that it was desirable above all other methods to start an Admiralty establishment, preferably by acquiring the business of Malby and Sons. An estimate for such purchase was given as £36 000 plus goodwill. *Inter alia* the report mentioned the department's lack of knowledge of the methods of foreign departments. It had shown its own methods to many and had only casually learnt of a German erasing-machine, while it had not paid a single visit overseas.

In February 1914 the disadvantages and increased costs of a sub-division between Malby's and another were again detailed in objection to a Finance Committee proposal. In November 1914, three months after war had broken out, the Hydrographer, now Parry, made a further report, this time against a proposal to form a joint-stock company, although it would tend to preserve the continuity of the firm. He showed that resistance in the past to new methods had so prevailed at Malby's, both in printing and assembly, that the situation had been saved only by the extension of naval preparations over a longer period than might have been anticipated. He recapitulated the advantages of an Admiralty printing establishment and noted the probability that it could take charge of its own sales to financial advantage. During the war years the matter rested, but by one means or another, such as photo-lithography, all requirements were met. In 1919 came the decision in principle to set up the Admiralty Chart Establishment at Cricklewood, in association with H.M.S.O., and Malby was paid £25 000.

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[1] File H.D. 420/1913.

Sales arrangements continued unchanged, although the Exchequer and Audit Department made the suggestion in 1909 that the agency should go out to tender, to which the Hydrographer rejoined that no change in Potter's agreement was desirable unless it could be shown that another would do it better.

In 1913, the prices of fifty charts, selected solely because they were most in demand, were raised by one shilling. It was entirely against the Hydrographer's advice and resulted in protests, as he forecast. Later in the year, he illustrated the impracticability of the suggestion made by a select committee of the House of Commons that the cost of surveys should be taken into account when fixing the prices of charts. He noted that some charts were compiled from surveys by H.M. ships, and others from foreign or other material obtained in exchange or at no cost to the Admiralty. There was also the unknown number of years that a survey would hold good.

In his reports of October 1913 and June 1914[1] the Hydrographer again emphasized that the department's existence was essential for naval purposes and that the Navy was indebted to the mercantile marine by reason of its exemption from light dues and the like. He showed that Admiralty charts were already dearer than those of other nations and the commercial 'blue-backs', that printing by lithography, as now largely used instead of direct from the copper plate, produced an inferior though practical and satisfactory result, and that an increase in price must reduce purchases of new editions. He challenged the select committee's figures and pointed out that in 1912–13 the total cost of the department was £19 000, chart printing and so on was £41 000, surveys and contingencies £26 000, while sales receipts had been £40 000 with the value of charts supplied to the Navy and others £55 000. Of the sales receipts, only twenty per cent represented printing costs, and some £33 000 went towards reducing the Navy Vote.

The coupon scheme for Sailing Directions begun in 1908 was modified in 1911, so that Potter no longer had to pay for supplements for which he could not produce coupons. The Treasury now agreed that H.M.S.O. should make a free issue of supplements up to the number of Sailing Directions purchased.

The effect of the Copyright Act of 1911 was discussed by the Hydrographer in 1912 when he showed that engraving 'Crown copyright reserved' on all

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[1] File H.D. 1007/1913.

Admiralty chart plates would cost £200. He could see no advantage in so doing, since the Admiralty freely copied the charts of others and permitted them to do likewise. In fact, it could act to the Admiralty's disadvantage. As a result H.M.S.O. said that it was permissible to omit the protective words.

Compass Branch was divorced from the Hydrographer in November 1911, after an association over a period of some seventy-four years. Prior to the change the Hydrographer had, early in 1910, supported the appeal of the superintendent, Chetwynd, for the reinstatement of the third officer who had been reduced in 1907 as a result of the report of the 1905 committee. Work had now increased—for instance, there were forty-four new ships to be swung in 1910, and in June an officer, Anderson, was appointed for a period of six months.

In 1910 more Anschutz gyro-compasses were ordered after another visit to Kiel by the superintendent and an electrical engineer, so that there were a dozen undergoing trials. In June of the following year there is a record that Mr S. C. Brown asked for an appointment for Mr Sperry and fortunately, as events transpired, comparative trials of the American Sperry compass with the German Anschutz in 1913 showed that the former was superior. Also in 1910, on representations from the Fleet, the graduation of compass cards from 0 to 360 degrees was begun, the advent of the gyro-compass being seen as a suitable occasion for the change. In 1911 there was mention of aeroplane compasses of the Chetwynd pattern for naval biplanes at Eastchurch.

In November 1910 Purey-Cust sought the Board's appreciation of Chetwynd's outstanding services, recalling his predecessor's submission of 1907 and the award to Chetwynd earlier in 1910 of £2 700 for the use of his patented inventions. This resulted in Chetwynd's promotion to captain on the Retired List in December 1910.

Then, in March 1911, an establishments committee considered the extension of the appointment of the third officer and, after the Hydrographer had answered a Treasury inquiry, an appointment for three years was agreed in October. The committee at the same time found that the Astronomer Royal was, for scientific reasons, willing to take over terrestrial magnetism and ready to do so without increase of staff. Thus were removed the objections that the Hydrographer had put before the 1905 committee, and the way was now open for the transfer of Compass Branch to the Controller. The change was announced in an office memorandum of November 1911. The Hydrographer, however, in view of his responsibility to advise on all navigational equipment, asked to be kept informed by seeing papers after action by the Superintendent of Compasses. The records of the branch went with it and are now located at the Compass Observatory, Slough, which was established in 1917 to house the new department including the Deptford Observatory. Chetwynd was succeeded in 1912 by his assistant Creagh-Osborne.

The Royal Observatory at Greenwich, where Dyson succeeded Christie as Astronomer Royal in 1910, and the observatory at the Cape, under Hough, required the attention of the Hydrographer from time to time. There were staff problems, such as the status and number of established computers, and in 1910 the Admiralty reserved the right not to present to Parliament those parts of the report of the Board of Visitors which discussed staff matters. The photo-mapping of the heavens continued at the Cape, with computations at Greenwich. It was the subject of a conference in Paris during 1911, and subsequently one established computer was added to the Cape staff. Once again, in 1913, a transfer of the observatory to the South African Government was mooted. As already mentioned, the Astronomer Royal took over terrestrial magnetism from the Hydrographer in 1911, and in 1914 the Royal Society proposed a magnetic survey of the British Isles. There was naval assistance to eclipse expeditions in 1910 and 1912.

Wireless time signals came into more general use, and the Royal Observatory cooperated in the daily signal from the Eiffel Tower. There was a proposal in 1913 for the adoption of the 24-hour system for reckoning time, but it was not to come about until 1925. Arrangements between the Hydrographer and the Astronomer Royal for the issue of chronometers were simplified in January 1912. The latter undertook their dispatch without increase of staff, and an annual audit of chronometers and watches at the Royal Observatory by Hydrographic Department staff was instituted. Establishments of chronometers and watches afloat were again revised in 1914.

At the Nautical Almanac Office, Cowell was selected, in consultation with the Royal Society and others, to succeed Downing in 1910. Part I of *The Nautical Almanac* was revised in 1911 to meet modern navigational needs. In the same year, after a conference of astronomers in Paris, the exchange of British and American calculations was commenced, the arrangement being terminable at one year's notice and subject to review after four years' working.

Some other matters on which the Hydrographer advised the Board may be mentioned, a number being in association with the Board of Trade. There were amendments to the rule of the road at sea and further proposals by the Admiralty in 1909 and 1911 that the Merchant Shipping Act should be amended so that there could be prosecution in the event of an infringement. Marston from the department continued to give valuable service on the interdepartmental committee on pilotage in the United Kingdom. When it reported in 1911, he had to reserve the Admiralty's position that there should be acceptance of responsibility by pilots where pilotage was compulsory.

In 1909, the Board of Trade Notice to Fishermen set out the conditions to be fulfilled before the Admiralty could be liable in claims for compensation, which had continued to be numerous. In 1912 and 1913, subsequent to the *Titanic* disaster, there were discussions on Atlantic steamship routes, with special reference to the *Mauretania* and *Lusitania*. They included an organization for ice reporting and the supply of instruments to the ice-observation vessel *Scotia*.

The United Kingdom was not represented at the 1912 International Maritime Conference at St Petersburg (Petrograd from 1914), and when the Hydrographer asked to see a report of its proceedings, he no doubt found that a further meeting specifically to discuss matters of international hydrography had been mooted.[1]

Discussion on the protection of submarine cables from damage by trawlers continued, and a minute of December 1909 showed that the arrangements were complete for the Government inspection of trawls as had been recommended by the interdepartmental committee in 1908. Certain telegraph companies continued to be dissatisfied. The Foreign Office thought it likely that the German Government might be asked to call an international conference with the object of proscribing fishing in a large area westward of Iceland; and the advisability of the United Kingdom's taking the initiative was considered on a proposal from the Post Office. The Hydrographer's comment was that it was a difficult question of two conflicting national interests, and that the Admiralty should be represented at any conference. There was a standing interdepartmental subcommittee, and in 1911 the Admiralty maintained their decision not to show cables on Admiralty charts.[2]

The Hydrographer continued to advise on questions of territorial waters and when, in 1911, Russia proposed a conference he was opposed to it. He agreed with his predecessor's objection to increasing the three-mile limit to six and said that the arguments applied with even greater force to the Russian proposal for twelve miles. A few months later he explained a ten-mile bay-line as being acceptable in fishery conventions only, although a territorial-waters limit could be three miles outside a line six miles long joining the headlands across a bay. The Hydrographer continued to be a member of the Meteorological Committee. Weather-forecasts, begun to destroyer flotillas in 1904, were extended to the Home Fleet in 1909, and in 1910 they were issued nightly from Cleethorpes W/T station.

There was information in 1910 that the Russians used helm orders opposite to the general practice, and in 1911 the Hydrographer commented on a proposal from Captain Jemo that it would be unwise to make a change unless the Merchant Navy did so too. The objections were greater than the advantages, and the majority of officers were against a change. It was to be many years before it was introduced.

Advice was given to the Commander-in-Chief, Australia, on the lighting of Australian coasts, and for his report Commander Brewis received Their

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[1] See p. 312.

[2] In recent years (1966) the policy has changed, with the result that cables are now more freely charted. In 1930 the Ministry of Agriculture and Fisheries issued a warning-notice that confirmed the continuation of their inspection of trawling-gear. It should be noted, however, that the International Convention of 1884, ratified in 1888, carried one Article to the effect that fishermen and others who sacrificed gear in order to avoid injury to a cable could claim compensation from its owners. Another accepted that the freedom of action of belligerents was not affected. See p. 125.

Lordships' approbation in 1913. After the Imperial Conference of 1911, an Australian Navy Board Order of October had promulgated royal approval to the title Royal Australian Navy; and in 1914 the Hydrographer suggested candidates for the post of Australian Director of Navigation.

In 1913, Turkish officers were given instruction in the department, Turkey having set up a hydrographic office in 1909, which then brought the total of hydrographic offices to twenty-four.

There continued to be advocates of the Forth-Clyde Canal, so that the Hydrographer was again called upon for remarks in 1912. Approval was given in 1913 for the presentation to the Royal National Lifeboat Institution of a set of Admiralty charts for the United Kingdom.

In October 1910 the Hydrographer caused the Board to object to the Board of Agriculture and Fisheries[1] on their use of ' hydrographer ' for one of their officers. There was an interesting discussion on alternatives, such as oceanographer,[2] but the Admiralty had to agree to the title ' Hydrographer to the Board of Agriculture and Fisheries' after the latter Board had shown that Dr Jee was concerned with North Sea investigations that had begun in 1899. The International Council for the Exploration of the Sea saw the opening of the Panama Canal as an occasion for ships proceeding by the new route to make observations for improving knowledge of the Atlantic. Field, Purey-Cust's predecessor, attended the opening of the Oceanographic Museum at Monaco in 1910 and, later in the year, a South American scientific congress. Monro succeeded Frederick as Professional Officer at the Board of Trade in 1910, the Hydrographer being asked to put forward more than one name, since it was for the Board to make the appointment.

Progress of marine surveys[3]

Within a few weeks of his appointment as Hydrographer, Purey-Cust took up with the Board, on 16 October 1909, the importance of the North Sea owing to the concentration of the Fleet in home waters and to ' the fact that *when*[4] war breaks out that ocean will probably be the principal theatre of operations '. He referred to a repositioning of light-vessels which was under discussion with Trinity House and to the frequent irregularities of the bottom, with possible shoals dangerous to deep-draught ships. He noted that during the frequent misty or thick weather an accurate knowledge of depths was most essential, so that, with the constant use of the lead, a navigator could be confident; and failing this, ‘ that important factor the mobility of the Fleet may be at any time impaired ’. Its safety and mobility in fact justified the existence of the Hydrographic Department.

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[1] The Board of Agriculture, formed in 1889, became ' of Agriculture and Fisheries ' in 1903 when it took over salmon, fresh-water, and sea fisheries from the Board of Trade. It became a Ministry in 1919.

[2] Minute-book 89, file 12.

[3] Details of the principal surveys carried out during the period at home and abroad have been summarized from the annual reports and are on pages 280 to 289.

[4] Author's italics.

The surveys would take some years and could start in April 1910 if the small paddle-steamers *Research*, *Triton*, and *Argo* in home waters could be supplemented by two small, handy vessels having good sea-keeping qualities; and Purey-Cust suggested two of the latest Grimsby trawlers at £6 000 to £8 000 apiece. There was also need for a ship and he took up the replacement of the *Egeria*, which in 1908 had been stood over until 1910. Part of the £60 000 then mentioned could be used for the trawlers and for an improved ‘ Triton ’, probably to be found on the market at £10 000. On being asked for details, the Hydrographer said the ship should be 1 400 tons and 200 feet long, have a speed of 13 knots and a 12-foot draught, carry two steam cutters, two whalers, and three skiffs. The complement should be 75 including a captain and seven officers, and a chart-room on deck. The upshot was the adaptation of H.M.S. *Hearty*, 1 300 tons, 212 feet long, and 14 feet draught.

The *Hearty* commissioned in April 1910 and sailed in June under Monro for the survey of Smiths Knoll and Well Bank. Four cruisers, H.M. Ships *Apollo*, *Thetis*, *Iphigenia*, and *Latona*, assisted, two at a time. They were anchored in prearranged positions and the *Hearty* sounded round them. An attempt to continue without their help in the second half of the year, and with floating moored beacons in lieu was abandoned owing to the slow progress, but the work was resumed in 1911, with the *Hearty* now under Learmonth, and in addition to the cruisers mentioned above, the *Andromache*, *Intrepid*, *Speedwell*, and *Speedy* were allocated for various periods.

By 1912, after a decision that the purchase of new vessels was preferable, the *Daisy* and *Esther*, two trawler-type vessels of 450 tons, specially built by Duthie & Co., Aberdeen, for the North Sea survey, were operating. Purey-Cust would have preferred the names ‘ Beacon ’ and ‘ Firefly ’ or ‘ Blossom ’. They were commanded by Geary-Hill and Peebles under the over-all command of Learmonth in the *Hearty* on The Would and Leman Bank.

In August of that year the *Endeavour*, ‘ first of her class ’, specially built for ocean-going surveying by the Shipbuilding, Engineering Company at Govan on the Clyde and ‘ complete with all modern appliances including wireless telegraphy ’, was commissioned by Hardy at Sheerness. She was considered as the replacement for the *Egeria*, while the *Hearty* took the place of the *Ellinor* on the closure of the Newfoundland survey. She was a single-screw ship, though the Hydrographer, after studying plans of the U.S.S. *Pathfinder*, had asked for a twin-screw ship; and like other foreign-going surveying ships, she was painted white with a yellow funnel, whereas the trawlers were black. The Hydrographer embarked for the *Endeavour*'s first cruise and visited the *Hearty*'s group at Lowestoft, and the *Research* at Cromarty, *en route* for the Shetlands where he left the ship to the task of surveying Balta Sound.

In May 1913, the officers and men of the *Hearty* and *Endeavour* were exchanged, and Learmonth in the latter ship, with the *Daisy* and *Esther*, continued the survey of the approaches to The Would between Winterton Ness and Haisborough Gat, finding many changes; he then surveyed the Outer Dowsing to Swarte Bank. The Hydrographer joined the *Endeavour* in September in the Firth of Forth, where he inspected the works in progress and sailed in her to see the anchorages and harbours of the Orkneys and Shetlands before disembarking at Loch Linnhe. The *Endeavour* then returned to the Orkneys to continue the *Hearty*'s survey of the previous year at Deerness. Later she rejoined her tenders, taking off-shore soundings from Aberdeen to St Abb's. The *Hearty* had meanwhile been surveying Cromarty and Invergordon, and in August sailed for Stromness to continue Balta and Uyea Sounds, meeting the *Endeavour* there, and with the Hydrographer on board proceeding in company to Sullom Voe. The year 1914 saw a continuation of these surveys in the North Sea by Learmonth in the *Endeavour*, with the *Daisy* and *Esther*, and in the Shetlands by Edgell in the *Hearty* until the outbreak of war.

In home waters the *Research*, Simpson, Pasco, and from 1912 Somerville, was first engaged in the examination of shoals and ledges off the south coast of England, which occasioned the development of the ship's drift-sweep, to be described; and she attended the Coronation Review at Spithead in 1911. Thereafter, she was mainly on the west coast of Scotland, including the approaches to the Clyde, but she was also at Dornoch Firth on the east coast. The *Triton*, with Penfold in command throughout the period, was on the east coast in the Thames and Medway and at Harwich and Dover, while the south-coast survey under May in the *Sir James* was engaged at Plymouth, Portsmouth, and in The Solent.

There was also the west-coast party in the *Argo*, Somerville, working at Bantry Bay, the Hebrides, Gare Loch and also on the east coast at Dornoch Firth. In 1912 the party, successively under Gibson, Tinson, and Hancock, used the hired launch *Roselight* and thereafter had the assistance of several of H.M. ships, the *Iphigenia*, *Andromache*, *Thetis*, *Apollo*, and *Intrepid*, for surveys of Ayr Bar, Shetlands, Holy Loch and the river Shannon. This party was discontinued in 1913, but in 1914 Combe was employed to visit various ports on the coast of England to bring the Admiralty charts up to date.

Abroad, the *Ellinor*, Combe, concluded the Newfoundland survey, which had been going on almost continuously since 1814, Cook having contributed a survey of Harbour Grace in 1762. In 1912 the *Ellinor* was sent to Jamaica, West Indies, and in the following year was returned to her owners in England. In 1914, surveys of the West Indies were taken up in the Bahamas by the *Mutine*, Glennie.

In British Columbia, the *Egeria*, Parry, concluded the surveys she had begun in 1898, and in 1910 was paid off for sale at Esquimalt the following year. This reduced the number of ships abroad to five, which was further reduced to four when the *Waterwitch* was run down and sunk at anchor in Singapore

Roads in 1912, an eventful year since, as remarked, it included the commissioning of the *Endeavour*, *Daisy*, and *Esther*.

On the African coasts, the *Mutine*, Hardy, later Edgell, continued the surveys of the Liberian coast and the Gold Coast with alternative work on the south and east coasts of Africa. The latter was undertaken under the pressure of demand from shipping companies, and the Hydrographer considered that the relative importance of the Liberian coast survey, which had been requested by the Foreign Office in 1901, had lessened. It was agreed that help from the land surveyors of Natal in marking the coast was acceptable in lieu of that Government's meeting half the cost of the survey during 1911 to 1913. In 1910, the *Mutine* gave facilities to Professor Beattie who was engaged on a magnetic survey of South Africa.

In 1910–11 Spicer-Simpson surveyed the river Gambia under the Crown Agents for the Colonies. In 1911–12, Whitehouse and a recorder used local craft for resurveys at Gibraltar and Malta.

In the China Seas the *Merlin*, Learmonth 1910, Davy 1911, Pasco 1912–13, and Gibson 1914, was entirely on the north and west coast of Borneo, although while at Hong Kong in 1913, a resurvey of that harbour was undertaken. In the Straits Settlements the *Waterwitch*, Hancock and Reyne, took over from the *Sealark* and surveyed Singapore Strait and approaches until she was sunk in 1912.

In Australasia the *Sealark*, Glennie and Hancock, worked in the Solomon Islands and alternatively in the northern part of the Queensland inner route, and the *Fantôme*, Pasco, Nares 1911–12, and Reyne 1913–14, carried on the survey of the north-west coast of Australia, the costs being shared. She was alternatively employed on the north coast of Tasmania, and in 1912–13 surveyed Sydney Harbour. Arrangements for surveys in Australian waters were further discussed with the Commonwealth Government from 1911 without a conclusion. In 1913 the issue was affected by the establishment of an Australian naval service and the need for surveys in connexion with defence.

The Marine Survey of India, now under Hickman, spent some time each season from 1911 onwards in the Persian Gulf on surveys of the Shatt al Arab, Bahrein, and Bunder Abbas. Some assistance was given by H.M. ships in lieu of a governmental financial arrangement. From Canada, results of surveys were received from the Hydrographic Survey Branch of the Department of Marine and Fisheries or the Department of Naval Service.

Special information for the Fleet of the Belts, Kattegat, and the Baltic was obtained by Brandon and Peile embarked in H.M.S. *Cornwall* during 1909. The following year, Brandon could not be spared to go to Germany to study the language, and his subsequent arrest when yachting in German waters is referred to in the biographical notes on his service.

Various harbour authorities referred their surveying problems to the Hydrographer, and at the end of 1909 Pudsey Dawson retired to take up the post of Chief Marine Surveyor to the Port of London Authority.

On the outbreak of war in 1914, surveying operations were temporarily suspended, and officers were distributed throughout the Fleet, many of them being specially appointed for surveying work connected with Fleet operations. The war work is described in Chapter 5.

The annual report for 1912 showed that there were in the ships 88 officers, of which 68 were surveying officers, and 845 men. The number of volunteers for surveying was not unsatisfactory, although appointments of general-service officers were occasionally made to fill vacancies. Advancements in grade continued to be made on the strength of reports by commanding officers on zeal and ability, and paymasters or surgeons were employed as assistant surveyors. The appointment of surveying officers as first lieutenant or navigating officer was regularized from 1909. In 1910 an appointment to the Hydrographic Department was agreed to be akin to an appointment to a home surveying ship for the purpose of the continuous receipt of surveying pay when appointments were consecutive. And the Hydrographer sent in recommendations half-yearly for promotion to captain or commander.

There were no new editions of *General Instructions for Hydrographic Surveyors* or of *Hydrographical Surveying* during the period. There was, however, a new issue—the *Hydrographic Annual.* The first one for the year 1912 was published by H.M.S.O. in 1913, and No. 2 followed in 1914, but these annuals, of which there are copies in the Hydrographic Department's archives, did not reappear after the war. As Purey-Cust's preface said, the *Hydrographic Annual* was to establish a readier means for the interchange of ideas and practical experience, and officers ashore and afloat were invited to contribute. To some extent it took the place of separate Hydrographic Department publications, which were begun in 1833 and were listed in the 1915 edition of *General Instructions for Hydrographic Surveyors.* The list has been continued, and the department's archives hold an almost complete collection of record copies, some of which are also in the Naval Library or the British Museum. Further details are given in Appendix C, 6.

One of the *Hydrographic Annual*'s features was on sweeping for the discovery of rocks using the ship or her boats, and it was introduced in a memorandum by the Hydrographer in June 1911. This noted that the increase in the draught of modern vessels made it more than ever necessary to examine all navigable channels when the nature of the bottom or the neighbouring shore was known to be rocky, and there was the necessity of devising means for discovering pinnacle rocks of which, in spite of the closeness of the soundings, no indications had been found. It was to be borne in mind that a depth of thirty-two feet in smooth water, or forty feet with any scend of the sea was a danger. There followed reports on a ship sweep from Pasco in the *Research* amplified later by Somerville, on a boat sweep by Combe in the *Ellinor* at St John's, on the use of a lighter by Penfold in the *Triton* at Sheerness, on the *Sealark*'s sweep, and on an otter sweep using a boat designed by J. M. Jackson.

Following the loss of submarine *A7* in Cawsand Bay early in 1914, the

Hydrographer prepared a memorandum in April on methods of sweeping for wrecks, which was sent to the Commander-in-Chief, Home Fleet. It described the surveying-ship drift-sweep and a longer one slung below picket-boats or torpedo-boats spaced over a distance of 1 000 feet, of which the United States Coast and Geodetic Survey had had successful experience. There had to be an absence of wind for drift-sweeping, and if there was no tidal drift, the sweep could probably be towed at a speed not exceeding one knot without the sweep-wire lifting.

Methods of ship sounding were described by Somerville in the *Research.* There had previously been the Douglas/Schafer sounding-traveller, instructions for the use of which were issued in 1912. It was also described in *Hydrographical Surveying*, 1920 edition, together with much of what had appeared in the *Hydrographic Annual*. Somerville's design, however, meant that the lead had no longer to be reattached to the rounding-line after each sounding, and he soon added an improvement whereby a counterpoise weight towing astern kept the depth line taut. This gear remained unaltered until the days of echo-sounding some twenty years later.

Somerville, acting on Purey-Cust's suggestion, also attempted an outrigger sounding-gear for boats, which was illustrated in the *Hydrographic Annual.* A Thomson sounding-machine was used to heave the lead forward, and a Lucas machine for the depth line, but the idea was abandoned, since, though more soundings could be taken with less labour, a greater speed of the boat could not be attained. So, heaving the lead by hand was to continue until the advent of echo-sounding; and in the present author's experience some seamen achieved remarkable skill despite the closeness of the chains to the water and the movement of the boat. Somerville also experimented with roller-sounding. A vacuum tide-gauge was described by Purey-Cust. Evinrude detachable motors for boats became available in 1913.

In addition the *Hydrographic Annual* contained historical sketches of the British Columbia survey by Parry and of the Newfoundland survey by Rupert Jones, and a definition of a nautical mile. There were contributions from Underhill on Admiralty charts and Atherton on a gnomonic graduation and on the length of a minute of longitude at the equator.

Lastly in this section on the progress of marine surveys, there was an important document[1] in which the First Lord, Winston Churchill, in April 1914 sought information from the Hydrographer on his employment of surveying vessels, the need for the various surveys and the dates of their completion. In particular he questioned commitments to other authorities such as the Commonwealth of Australia. The Hydrographer's detailed reply stressed the importance at home of the North Sea surveys, the end of which could not be foreseen, and abroad of Singapore Strait with its approaches, while the *Mutine*'s work in the West Indies had been occasioned by the opening of the Panama Canal. He recalled the colonial developments since 1904, showing that only Canada was able to undertake its own work while joint arrangements had been made with Australia, New Zealand, and Cape Colony. The first of these was continuing on the north-west coast pending the result of a further proposal in 1912 that Australia should provide her own ship. However, on being asked for further details a month later the Hydrographer thought the progress of the other survey on the Queensland coast and the basing of H.M. ships on New Zealand now made it a matter for consideration that the latter's surveys should take precedence. He suggested that in view of New Zealand's recent valuable contribution to the Navy, the survey should be at Admiralty expense. As for the Solomon Islands, specifically mentioned by the First Lord, Purey-Cust said he was not aware that anything had occurred to modify the views held by the Commander-in-Chief, Australia, regarding their importance, lying as they did on the direct route from Australia to Japan.

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[1] File H.D. 280/1914.

The report repeated what had previously been said about the need, and constant requests, for more detailed surveys in waters of the Colonies an dependencies and on trade routes for the safety of the Fleet and the merchant marine. It again referred to the Navy's exemption from light and harbour dues and to the supply of hydrographic information from many merchant vessels. It estimated that the 1913–14 costs of the surveying service would be £123 312, and of the department, together with printing, £57 284. Sales receipts were £43 379; supplies to the Fleet £58 548. This left no more than £78 569 sunk in a service, the ships of which provided, moreover, a training-ground for officers and men who would be required in war.

Purey-Cust recalled that the foreign surveys had, since 1910, been reduced from seven to five, and, with the loss of the *Waterwitch* in 1912, there were now only four vessels. He strongly deprecated any reduction in the number of ships at home and abroad and pressed for a replacement for the *Waterwitch*. He concluded: 'In view of the priceless value of trustworthy charts, for ensuring the safety and mobility, both in peace and war times, of our great and increasing Fleet, for safeguarding life at sea and for facilitating maritime commerce, the great source of our national prosperity, the net cost of the existing hydrographic service ashore and afloat is ridiculously small, some £78 000, compared with the very great interests involved. It could and should be with advantage increased rather than diminished.'

As an appendix the Hydrographer added a 'Statement of Hydrographical Knowledge of the Coasts and Oceans . . .', pointing out that the last such review was by Wharton in the 1885 edition of the Admiralty *Manual of Scientific Enquiry*. It noted the contributions of the great maritime nations over the last thirty years and said that if the result did not compare favourably with the rapid advances of the nineteenth century, it was due to the rapid methods of reconnaissance and exploration then justifiably employed in the construction of charts for the use of vessels of that period.

The war soon intervened, and after it had ended, the reconstitution of the surveying fleet was begun by Parry. It was completed in Learmonth's period of office as Hydrographer from 1920 to 1924.

Biographies: Afloat and ashore

REAR-ADMIRAL C. H. SIMPSON, C.B.E.

1894–1911

Cortland Herbert Simpson began surveying as a lieutenant in 1881 when he joined the *Flying Fish*, Hoskyn, on the China Station where a year later he commissioned the *Rambler*, Vereker. He remained on the China Station, including Borneo waters, until 1889, the last three years being under Moore. He was next in the *Stork*, Balfour, later Smyth, for three years' work on the east coast of Africa, in the Seychelles, the Red Sea, and the Mediterranean. After leaving the *Stork* he served in home waters for two years, first in the *Research*, Vereker, and then in the *Triton*, Richards.

In 1894 Simpson obtained his first command, succeeding his former commanding officer, Smyth, in the *Stork*, and for three years he surveyed in the Mediterranean, being promoted to commander in 1896. From 1898, for about eighteen months, he was a naval assistant in the department, after which, in 1900, he again succeeded Smyth afloat, this time in the *Egeria* in British Columbia. He spent three years there, during which time, at the end of 1903, he was promoted to captain.

From February 1904 until early 1905, Simpson was again a naval assistant in the department, and he then took command of the *Penguin* for two and a half years' surveying in Australian waters, mainly on the Queensland inner route. Finally, in 1908 he succeeded Smyth, for the third time, in the *Research* in home waters; and he retired in 1911.

Simpson was advanced to rear-admiral in 1913, and during the 1914–18 war he took a temporary commission as a captain, R.N.R. He was employed as an acting commodore second-class, and was awarded the C.B.E. in 1919 for his war services.

REAR-ADMIRAL W. PUDSEY DAWSON

1897–1910

Willoughby Pudsey Dawson began surveying as a sub-lieutenant in 1882 in the *Dart*, Moore, followed by Field, on the Australia Station, mainly in Tasmania, the New Hebrides, and New Guinea. Remaining there for seven years, he was promoted to lieutenant in 1884.

He joined *Egeria*, Oldham, later Field, in 1889, and served for two years and a half, first in the Pacific and then Borneo waters. In 1892 he went back to the *Dart*, now under Purey-Cust, and for another three years and a half was mainly in the New Hebrides. In 1896 he was in the *Penguin*, Field, and again in the Pacific.

In 1897 Pudsey Dawson obtained his first command, the *Waterwitch*, and after a year on the Queensland coast of Australia, he sailed for the China Station, breaking a spell of no less than sixteen years' surveying in Australasia. He remained in the *Waterwitch* until 1900, being promoted to commander in 1898. After a year as a naval assistant in the department, he commanded the *Penguin* from 1902 to 1905 in New Zealand waters, and was promoted to captain in 1904.

Returning home in 1905, Pudsey Dawson took command of the *Triton* in 1906 and remained in her until the end of 1909, during which service he surveyed Scapa Flow and approaches with a view to its use as the principal fleet anchorage in time of war.

He retired in 1910 to take up the appointment of Chief Marine Surveyor to the Port of London Authority, a position he held for fifteen years. He was made a rear-admiral in 1916 and died at Sydney, New South Wales, in 1936 aged seventy-five years.

Rear-Admiral C. E. MONRO

1900–1910

Charles Edward Monro joined the *Sylvia* as a lieutenant in 1885, and after a year under Aldrich and then Dawson, he transferred to the *Egeria*, Aldrich, later Oldham, firstly in the Gulf of Aden and Ceylon and then, until 1890, on exploratory surveys in the Pacific. After an interval of a year, he was appointed to the *Stork*, Smyth, in the Red Sea, the Seychelles, and East African waters, but after about eighteen months was invalided home.

In 1893 Monro joined the *Penguin*, Balfour, and spent three years surveying in the Solomon Islands, after which, and following two months in the *Research*, Moore, in home waters, he became a naval assistant in the department. He soon returned to sea service and was in the *Rambler*, Purey-Cust, in 1898 and 1899, her surveys ranging from North America and the West Indies to the west coast of Africa.

In 1909 he was given command of the *Dart* and for two years surveyed the inner route off the Queensland coast, being promoted to commander in 1901. On his return home, he was for a short time a naval assistant in the department and then took command of the *Rambler* at the end of 1903, in which ship he was engaged for two years and a half on the China Station, mainly in Borneo waters.

After another short period in the department as Surveying Officer for Special Business, Monro commissioned a new surveying ship, the *Mutine*, in 1907 for service on the west coast of Africa. The surveys were mainly on the Liberian coast, but in 1908 Ascension Island was visited for observations to redetermine the longitude of the Cape Observatory. He had been promoted to captain in 1907.

There followed, from August 1909 to April 1910, his temporary appointment in charge of Sailing Directions and as Assistant Hydrographer pending Parry's return from British Colombia. He then returned to sea service in the *Hearty*, newly allocated for North Sea surveys. However, in July 1910 Monro retired to take up the appointment of Professional Officer at the Board of Trade in succession to Frederick, filling the post for seventeen years.

Monro volunteered to act as night-duty officer in the department during the war in addition to his duties at the Board of Trade. A letter of thanks from Their Lordships in January 1918, when night-duty officers were no longer needed, acknowledged that Monro's dual role was at considerable inconvenience to himself. He was made a rear-admiral in 1919 and died in 1937.

Captain F. C. C. PASCO, R.N.

1902–1914

Frederick Claude Coote Pasco began surveying as a lieutenant in 1889 when he joined the *Paluma*, Pirie, for three years on the inner route off the Queensland coast. In 1892 he transferred to the *Dart*, Purey-Cust, for a further three years in Australasia, mainly in the New Hebrides. He next served in the *Waterwitch*, Combe, for two years in the Fiji Islands, and in 1897 was appointed to the *Penguin*, Field, later Combe, working in the Pacific or on the north-west coast of Australia.

In 1900, after eleven years on the Australia Station, Pasco returned to England, and after some six months observing tidal streams in the Channel Islands, he joined the *Research*, Field, in home waters. He then obtained command of the *Dart*, once more in Australasia from 1902–4, in the Solomon Islands and on the Queensland coast, being promoted to commander at the end of 1902.

In 1904 he joined the department for two years as a naval assistant and for a further two years he served as Superintendent of Charts in succession to Stanley. In 1908 he was again in Australasia in command of the *Fantôme*, mostly on the north-west coast of Australia, and was promoted to captain in 1909. For a year, in 1911, Pasco was in home waters in the *Research*, and he then went to the *Merlin* on the China Station for two years, mostly on the coasts of Borneo. He returned home early in 1914 and was placed on the Retired List the following year.

Pasco was lent to the Canadian Government for the whole of the 1914–18 war, and served with the Canadian naval forces.

Captain F. H. WALTER, R.N.

1905–1909

Frederick Henry Walter began surveying as a lieutenant in 1897 in the *Egeria*, Smyth, later Simpson, and served in British Columbian waters for six years. In 1903 he was appointed to the *Penguin*, Pudsey Dawson, for two years in New Zealand, followed by a short appointment as a naval assistant in the department.

Walter's first command was the *Goldfinch* on the coast of Liberia during 1905–6, and he was promoted to commander at the end of 1905. After another short spell in the department, he then, in 1907, succeeded Parry in the *Merlin* and for two years and a half was chiefly engaged on Borneo surveys.

In 1909 Walter reverted to general service and he retired a few years after he had been promoted to captain in 1918. While serving in H.M.S. *Odin*, he made a number of useful surveys in the Persian Gulf.

Captain B. O. M. DAVY, R.N.

1907–1911

Bishop Octavius Maturin Davy took up surveying in 1896 when, as a sub-lieutenant, he joined the *Waterwitch*, Combe, on the Australia Station. For two years, the surveys were mainly in the Fiji Islands, and for another two years, now under Pudsey Dawson, on the China Station. He was promoted to lieutenant in 1897.

Returning home in 1900, Davy was appointed to the *Research*, Field, for a year's surveying in home waters, and in 1902 he joined the *Goldfinch*, Learmonth, working for three years and a half, mainly on the west coast of Africa. In 1906 he followed Learmonth to the *Egeria* in British Columbia.

In 1907 Davy obtained command of the *Sealark*, surveying Ceylon and later the west coast of Siam. He was promoted to commander in 1908. In 1910 he returned to England and succeeded Monro in command of the *Hearty* in home waters. The next year he went to the *Merlin*, surveying in Borneo, where he was succeeded by Pasco in 1912.

In 1913 he was appointed as a naval assistant in the department, serving as such for fifteen years and becoming Superintendent of Sailing Directions in 1919. He was placed on the Retired List with the rank of captain in 1925.

In 1940 Davy volunteered for war service and was re-employed in the department until 1945 mainly on information concerning wrecks.

Captain L. D. PENFOLD, R.N.

1910–1914

Lewis Dudley Penfold joined the *Stork*, Simpson, as a lieutenant in 1894 and surveyed for three years in the Mediterranean. In 1897 he was appointed to the *Rambler*, Purey-Cust, where he served until 1901 on surveys in North America, the West Indies, and on the west coast of Africa.

On leaving the *Rambler*, Penfold served for one season in the *Research*, Field, in home waters, and in 1902 he was transferred to the *Triton* on the east coast of England, in which ship he was to remain for no less than twelve years until his retirement, with the rank of commander, in May 1914.

From 1902 to 1910 he served under Richards, Purey-Cust, and Pudsey Dawson successively, and he then took command of the ship. He had an unparalleled knowledge of the east coast of England.

For his services during the 1914–18 war, which included charge of the chart depot at Bermuda, Penfold was made a captain on the Retired List in November 1918. His son, D. N. Penfold, was to follow in his father's footsteps as a surveying officer.

CAPTAIN A. W. PEEBLES, D.S.O., M.V.O., R.N.

1912–1914

Aubrey William Peebles began surveying as a sub-lieutenant in 1901 when he joined the *Rambler*, Smyth, on the China Station for three years. He was promoted to lieutenant in 1902. In 1904 he spent a year in the *Triton*, Purey-Cust, in home waters and then went to the *Goldfinch*, Walter, surveying in the Mediterranean and on the west coast of Africa until the ship returned home to be put out of commission at the end of 1906.

Peebles next joined the *Research*, Smyth, for a year in home waters, following which he was in the *Sealark*, Davy, from 1907–9 surveying in Ceylon. On his return home, he spent a few months as a naval assistant in the department before going to the *Hearty* in home waters, where he served under Monro, Davy, and Learmonth in turn over a period of two years.

In 1912 Peebles, then a lieutenant and commander, was given command of the surveying trawler *Esther*, which, with her sister ship the *Daisy*, worked as a group on North Sea surveys under Learmonth, first in the *Hearty* and then the *Endeavour*. On the outbreak of the 1914–18 war he reverted to general service and joined the armed liner *Caronia*. He was awarded the D.S.O. for war service, was placed on the Retired List in 1923, and was advanced to the rank of captain in 1925.

T. H. BRIGGS

1874–1910

Briggs joined the department in 1874 as a third-class draughtsman, being promoted to second class the following year. In 1884, as a result of the 1883 committee's report, the six draughtsmen, of whom Briggs was one, became unclassified under one chief draughtsman, then Powell. In 1905 two chief draughtsmen were allowed, and Gibson was promoted though Briggs was his senior, but two years later Briggs succeeded Clark as a chief. In January

1909 draughtsmen achieved the title of cartographer, and three chief cartographers were established. Two of them were to be second grade, and Field, the Hydrographer, who had been so largely instrumental in obtaining the title of cartographer, demurred on Briggs's behalf. It seemed to be a step down from chief draughtsmen, but he was unsuccessful in getting a change to one senior chief and two chief cartographers.

When sixty, in January 1910, Briggs was allowed to complete another year for pension, and he was finally superannuated in March of that year.

THE PRINCIPAL SURVEYS OF 1910

HOME

Simpson	*Research*	England, east coast	Humber estuary
		England, south coast	Poole, shoal examinations
		Scotland, west coast	Eddrachillis Bay
Monro, Davy	*Hearty*	North Sea	Smiths Knoll and Well Bank
		Scotland, east coast	St Andrews Bay
Penfold	*Triton*	England, east coast	The Medway, Dover, the Thames estuary
Somerville	*Argo*, h.v.*	Ireland, west coast	Bantry Bay
		Scotland, west coast	Loch Boisdale (Hebrides)
May	*Sir James*, h.v.	England, south coast	Plymouth, Portsmouth, Sandown Bay

FOREIGN

Combe	*Ellinor*, h.v.	Newfoundland	Bonne Bay to Labrador coast, Botwood
Parry, Nares	*Egeria*	British Columbia	Strait of Georgia
Pasco	*Fantôme*	Tasmania	Hobart
		Australia, north coast	Cape Leveque to James Price Point
Learmonth	*Merlin*	Borneo	Mount Pisang to Kudat, Sandakan Harbour
Hardy	*Mutine*	Africa, west coast	Liberian coast, Gold Coast, Sekondi
		Africa, south coast	Zululand coast, Table Bay
Davy, Glennie	*Sealark*	Malay Peninsula	Pulo Telibon to Pulo Terutan
		South Pacific	Guadalcanal to Florida Island
		Australia, east coast	Queensland coast
Hancock	*Waterwitch*	Malay Peninsula	Singapore Strait

BY THE MARINE SURVEY OF INDIA

Hickman	*Investigator*	BURMA INDIA	Coastal surveys West coast

Research examined by sounding a number of banks and ledges from St Albans to Tor Bay.

Hearty commissioned in April in special connexion with the North Sea survey. She was assisted by four cruisers, two at a time, anchored in prearranged positions while *Hearty* sounded round them. Davy succeeded Monro in August. Deep-sea tidal observations were on the whole satisfactory.

Four of H.M. cruisers did systematic observations for variation with special compasses in the North Sea, first swinging ships in company.

Triton found considerable shoaling between the Shingles Patch and Long Sand, the least depth being four feet against nine feet in 1904 and thirty in 1882. A new channel south of Shingles Patch was buoyed. Work in the Medway was for the floating dock.

Argo used the Caledonian Canal. Three dangers were found in the Kyles of Bute.

Egeria came to the end of her useful life and thirteen years work in British Columbia, being prepared for sale after 1 April 1911. J. D. Nares succeeded Parry in March.

Fantôme used Broome as her base during her coastal survey.

From *Merlin*, Learmonth joined a Government expedition to explore Mount Kina Balu, during which theodolite observations were made and communication by heliostat established with Jesselton.

Mutine made a start on South African surveys and in lieu of a financial contribution had the assistance of Natal Government surveyors.

Sealark found the Solomon Islanders helpful.

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* h.v. hired vessel.

THE PRINCIPAL SURVEYS OF 1911

HOME

Learmonth	*Hearty*	North sea	Hewett Ridge and Smiths Knoll
		Scotland, east coast	St Andrews Harbour
Pasco	*Research*	England, south coast	Fowey, sweeping off-lying shoals
Penfold	*Triton*	England, east coast	Sheerness Bar, Dover Harbour, Barrow Deep
Somerville	*Argo*, h.v.	Scotland, west coast	Gare Loch
		Scotland, east coast	Dornoch Firth
May	*Sir James*, h.v.	England, south coast	Plymouth, Portsmouth, Spithead, Southampton Water

FOREIGN

Combe	*Ellinor*, h.v.	Newfoundland	Bonne Bay to Labrador, Hare Bay
Nares	*Fantôme*	Australia, north coast	Buccaneer Archipelago
Davy	*Merlin*	Borneo	Labuan Island to Barram Point
Hardy	*Mutine*	Africa, west coast	Liberian and Gold Coasts
		South Africa	Natal coast
Glennie	*Sealark*	South Pacific	Solomon Islands, Florida Island
		Australia, east coast	Queensland inner route
Hancock	*Waterwitch*	Malay Peninsula	Singapore Strait eastern approaches

BY THE MARINE SURVEY OF INDIA

Hickman	*Investigator*	Burma	Coastal surveys
		India	West coast
		Persian Gulf	Shatt al Arab

Hearty was again assisted by various H.M. ships, of the third-division Home Fleet. Widely-spaced tidal observations were successful using the deep-sea pneumatic apparatus. Abnormal refraction was disproved with a Pulfriecher dip-measurer.

Research did much sweeping of shoals on the south coast using equipment described in the *Hydrographic Annual* mentioned. She attended the Coronation Review at Spithead in May.

Triton found the Shingles Patch no longer shoaling. May was detached to Mizen Head, east coast of Ireland, in connexion with proposed torpedo-ranges.

Fantôme also surveyed Goode Island anchorage. Camping-parties were landed as the intricate nature of the Buccaneer Archipelago prevented the ship from approaching the mainland in the vicinity.

Merlin searched the shoal south-east of Hong Kong, reported by U.S.S. *Helena* in 1907, but was interrupted by bad weather after finding indications. She attended Coronation celebrations at Sandakan in May as did *Waterwitch* at Penang.

Mutine made unsuccessful searches for shoals reported off Port Nolloth and Cape Frio. The ' smokes ' hindered work on the Liberian coast.

Sealark on the Queensland inner route from Cairns to North Barnard Islands found another pinnacle rock not far from the usual course taken by shipping.

THE PRINCIPAL SURVEYS OF 1912

HOME

Learmonth Geary-Hill Peebles	*Hearty* *Daisy* *Esther*	North Sea	The Would and Leman Bank, Cromer and Smiths Knoll
		Scotland, east coast	St Abb's to Aberdeen
		Orkney Islands	Deer Sound
Hardy	*Endeavour*	Shetland Islands	
Somerville	*Research*	Scotland, west coast	Tarbert Loch and Bank, Sound of Islay
Penfold	*Triton*	England, east coast	The Medway, Thames estuary, Dover Strait, Harwich approaches
Gibson, Tinson, Hancock	*Roselight*, h.v.	England, west coast	Ayr Bay
		Shetland Islands	
		Ireland, west coast	The Shannon
May	*Sir James*, h.v.	England, south coast	Plymouth, Portsmouth

FOREIGN

Combe	*Ellinor*, h.v.	Newfoundland	St John's Harbour
		West Indies	Port Royal (Jamaica)
Pasco	*Merlin*	Borneo	Labuan approach, Samarang Bank to Ampi Shoal
Glennie	*Sealark*	South Pacific	Solomon Islands, Guadalcanal
		Australia, east coast	Queensland inner route
Nares	*Fantôme*	Tasmania	North Coast.
		Australia, east coast	Sydney Harbour
		Australia, north coast	Buccaneer Archipelago
Reyne	*Waterwitch*	Malay Peninsula	Singapore Main Strait
Edgell	*Mutine*	Africa, west coast	Liberian coast
		Mediterranean	Gibraltar, Tetuan Bay

BY THE MARINE SURVEY OF INDIA

Hickman	*Investigator*	BAY OF BENGAL	Tenasserim coast, Nancowry Harbour
		PERSIAN GULF	Bahrein approaches

Hearty was assisted by *Daisy* from April and *Esther* from August. They were two trawler-type vessels specially built for the North Sea survey, which replaced the cruisers used in the two previous years. A floating triangulation was rapidly carried out with three vessels and the new and successful Egeria beacon. A new Hearty Knoll was found extending from Winterton Ridge.

Endeavour was newly commissioned at Sheerness in August. The Hydrographer embarked at Harwich and inspected *Hearty* and *Daisy*, after which the three ships exercised at sea with beacons, the Douglas/Schafer sounding-gear and the pneumatic tidal apparatus. The Hydrographer then inspected harbours in the Shetlands, leaving *Endeavour* at Lerwick to continue the survey of Balta Sound.

Research was inspected at Cromarty in August and the Hydrographer saw the new Somerville sounding-gear, described in the *Hydrographic Annual* for 1913.

Triton took bottom samples between Dungeness, the Varne and St Margaret's Bay.

Roselight was paid off in May and the party was thereafter embarked in and assisted by several of H.M. ships.

Ellinor concluded the Newfoundland survey, which had been almost continuously carried on since 1814.

Fantôme found Bathurst Island wrongly charted by five miles. She grounded on a reef off Adele Island but refloated some hours later without damage.

Waterwitch was rammed and sunk at anchor in Singapore Roads on 1 September by the colonial Government yacht *Seamew*.

Mutine fractured a propeller-shaft in March and was towed into Sierra Leone by the cable-ship *Sentinel* and thence to Gibraltar by H.M.S. *Dartmouth*. The Board of Admiralty inspected *Mutine* at Gibraltar in June.

THE PRINCIPAL SURVEYS OF 1913

HOME

Learmonth	*Endeavour*	North Sea	Outer Dowsing and The Would
Geary-Hill	*Daisy*		
Peebles	*Esther*	Orkney Islands	Shapinsay Sound
Somerville	*Research*	Scotland, west coast	Ayr Bay, Clyde approaches, Loch Tarbert
Hardy	*Hearty*	Scotland, east coast Shetland Islands	Cromarty Firth Balta and Uyea Sounds
Penfold	*Triton*	England, east coast	Thames estuary, Medway, Dover and Harwich Harbours
May	*Sir James*, h.v.	England, south coast	The Solent, Plymouth Harbour
		England, east coast	Yarmouth Haven

FOREIGN

Combe	*Ellinor*, h.v.	West Indies	Kingston approaches (Jamaica)
Pasco	*Merlin*	China coast Borneo	Hong Kong Harbour Tutong to Labuan
Reyne	*Fantôme*	Australia, east coast Australia, north coast	Sydney Harbour Albert Reef to King Island, Battery Point
Hancock	*Sealark*	South Pacific	Solomon Islands, Malaita
		Australia, east coast	Queensland inner route
Edgell	*Mutine*	Africa, west coast	Liberian coast, Sububo Point to Cavally River
		South Africa	Saldanha Bay, Port Natal to Tugela River

BY THE MARINE SURVEY OF INDIA

Hickman	*Investigator*	Bay of Bengal Persian Gulf	Mergui Archipelago Clarence Strait, Henjam, Bahrein approaches

At the beginning of the season, *Endeavour* and *Hearty* exchanged officers and ships' companies. *Endeavour* tested the submarine bell signal of Swarte Bank light-vessel, hearing it at 10 miles or 21 miles when stopped. The three ships took tidal observations between Dogger Bank and Terschelling. The Hydrographer embarked and inspected Rosyth Dockyard works and anchorages in Orkney and Shetlands. He visited *Hearty* in Uyea Sound and *Research* in Ayr Bay.

Research's repairs at Southampton were delayed until June by a strike in the engineering trade. In July she found S.S. *Vivid* off Oronsay in a sinking condition through striking a rock, but a search of the area revealed no danger not already charted.

The west-coast-of-England survey was closed in March.

Ellinor arrived in England in March and was returned to her owners.

Mutine ran a meridian distance between Cape Palmas and Subbubo Point, and magnetic observations were made at the former place. The senior assistant, Harvey, was invalided home in February. At the end of the year *Mutine* was on passage from Simons Bay to Jamaica, taking deep-sea soundings via St Helena, Pernambuco, and Barbados.

THE PRINCIPAL SURVEYS OF 1914

HOME

Learmonth	*Endeavour*	North Sea	Various banks in continuation of previous surveys
Geary-Hill	*Daisy*		
Peebles	*Esther*		
Somerville	*Research*	Ireland Scotland, west coast	Berehaven, Lough Larne Firth of Clyde
Hardy, Edgell	*Hearty*	Scotland, west coast Shetland Islands	Colonsay Uyea Sound
Penfold, Tinson	*Triton*	England, east coast	Thames estuary channels, Mouse Bank
May	*Sir James*, h.v.	England, south coast	Devonport, Portsmouth
Combe		England, Scotland	Correcting charts of the larger ports

FOREIGN

Gibson	*Merlin*	Borneo	Brunei Bay and Vernon Bank
Reyne	*Fantôme*	Tasmania Australia, north coast	North coast Vicinity of Broome
Hancock	*Sealark*	South Pacific	New Hebrides, Solomon Islands
Glennie	*Mutine*	West Indies	The Bahamas

BY THE MARINE SURVEY OF INDIA

Hickman	*Investigator*	Bay of Bengal Persian Gulf	Mergui Archipelago Bunder Abbas, Henjam

On the outbreak of war in August, surveying operations were temporarily suspended, and officers were distributed throughout the Fleet, many of them being specially appointed for surveying work in connexion with the operations of the Fleet.

Endeavour, *Daisy* and *Esther* continued the surveys of the North Sea banks, and were inspected by the Hydrographer in June. *Endeavour* was employed on war requirements with a reduced staff while *Daisy* and *Esther* were appropriated to minesweeping.

In *Hearty*, Edgell relieved Hardy in May, and the ship was on special surveying duty after war broke out. Tinson succeeded Penfold in *Triton* in May.

Mr Lanyon continued the south-coast-of-England survey after the outbreak of war.

Sealark surveyed in the New Hebrides to examine the effect of a volcanic eruption. In August some officers and men joined the expeditionary force for Samoa.

Mutine was paid off at Bermuda and three promising young surveyors Benyon, Gray, and Smith were subsequently lost in H.M.S. *Good Hope* at the action off the Chilean coast in November.

The war work of the surveying service is described in Chapter 5.

5

Admiral Sir J. F. Parry, K.C.B.

HYDROGRAPHER 1914–1919

AFLOAT

Combe, E. C. Hardy, Somerville, Hancock, Comber,
J. M. Jackson, Warburg, Brandon

ASHORE

Gibson, Barber

John Franklin Parry, born in 1863, was the third son of the Rt Reverend Edward Parry, Bishop of Dover, and the grandson of W. E. Parry, a former Hydrographer. He entered the Navy as a cadet in 1877, becoming a midshipman in 1879 and sub-lieutenant in 1883.

He began surveying in 1884 when he joined the *Triton*, Tizard, for a season on the east coast of England; and towards the end of that year he went to the *Rambler*, Vereker followed by Moore, for four years and a half on surveys mainly of the China and Borneo coasts. He was promoted to lieutenant in 1885. In 1890 Parry joined the *Penguin*, Moore, and for three years was on the north-west coast of Australia or the China coast, following which, in 1894–95, he was again in the *Triton*, Richards and Pirie, in home waters. At the end of 1895 he went to the *Dart*, Howard, on the Australia Station. He obtained his first command when two years later he succeeded Howard. His promotion to commander followed in 1899. For over four years in the *Dart* his surveys were mainly of the Queensland inner route, where islets were successfully planted with coconuts for the use of navigation or for the benefit of shipwrecked mariners.

Returning to England in 1900, Parry was in the department under Wharton for a few months, indexing original documents of anterior date to 1795, and then for two years filling the post of Chief Civil Assistant. At sea again in 1903, he commanded *Egeria* for surveys of British Columbia waters for three years and was promoted to captain in 1905. In 1906 he commissioned a new surveying ship, the *Merlin*, in England for service on the China Station, but in December, while in the Red Sea, he contracted dysentery. At his own request and expense he took six months' leave on half pay in Tasmania to recuperate; and on his way home in 1907 he had a short appointment to *Egmont* in order to reconcile Malta's coastline with Combe's triangulation and to survey Marsa Scirocco's torpedo-range.

In 1908 Parry was again in the *Egeria* in British Columbia, but was soon under orders for Australia, during which projected surveys he asked unsuccessfully to act as an independent ship. The *Egeria* was, however, found unfit for this service and continued in British Columbia to the end of her useful life in 1910, Parry having left in March to take up the appointment, held temporarily by Monro, of Assistant Hydrographer to Purey-Cust. This was in the period when there was an Assistant Hydrographer (N) as well as an Assistant Hydrographer (H), and Purey-Cust had occasion to remark that harmony in the department had been maintained owing to the personalities of the two Assistants. In this appointment, Parry represented the Admiralty on the Board of Trade committee on derelicts and also at the conference on an Atlantic ice patrol following the loss of the *Titanic*. Additionally, he was British delegate to the French conference on the use of wireless telegraphy for time and weather signals and was chairman of the committee formed to inquire into the reorganization of Admiralty charts.

Thus Parry brought an unrivalled experience to his appointment as Hydrographer on 1 September 1914 and to a period of office that covered the war years of 1914–18. According to Edgell in *Sea Surveys*, Parry had a genius for organization, a sound judgment in his choice of staff, and a remarkable breadth of vision combined with a capacity for work. Luff in *For the Record*[1] remembers that Parry appeared to him, then a junior clerk in Issues Branch, as a typical sea-dog with red face, white hair, and commanding presence, always cheery and genial with the staff, whom he joined with his coat off to pack charts in the corridors of the Admiralty on the outbreak of war. Jackson in his first draft of these notes wrote that Parry commanded to a remarkable degree the affection and loyalty of his subordinates, that his personality and leadership meant that no wartime demand on the department remained unfulfilled, and that under him the surveying service built up a high reputation and proved its value in warlike operations. It is said that Parry and Hall, Director of Naval Intelligence, were personally instrumental in bringing women into the Admiralty during the war and that these women were known as Parry's peaches and 'Blinker's' beauties.

At the end of the war, Parry put in hand the reconstitution of the surveying fleet, although the ships were not commissioned until his successor's time. In 1918 he was chairman of a conference on timekeeping at sea, which established time zones and an astronomical day of twenty-four hours beginning at midnight. In 1919 he was chairman of the first International Hydrographic

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[1] Bibliography 3, 17.

Conference, which was held in London and which led to the establishment in Monaco of the International Hydrographic Bureau in 1921.

Parry was promoted to rear-admiral and awarded the C.B. in 1916; he was made a K.C.B. shortly before he handed over to Learmonth on 1 September 1919. On the Retired List he was advanced to vice-admiral in 1920 and admiral in 1925. He received the Cross of the Legion of Honour (France), the Distinguished Service Medal (U.S.A.), and was elected a Fellow of the Royal Geographical Society in 1917. To the *Hydrographic Annual* for 1913 he contributed ' An Historical Sketch of the Exploration and Survey of the Waters of British Columbia ', which was illustrated.

After retirement Parry went to the Gold Coast in 1920 on behalf of the Crown Agents for the Colonies in order to direct the surveys that resulted in the choice of Takoradi Bay as the site for a port. In the following year he was elected as the first presiding director of the International Hydrographic Bureau at Monaco, a post he filled until his death at Harrogate in 1926 aged sixty-five.

The contemporary scene

The 1914-18 war broke out on 4 August 1914, with Britain, France, Belgium and Russia ranged against Germany and Austria. The Allies were joined by Rumania and Italy in 1916, and by the United States, Greece, and Japan in 1917. The Central Powers were supported by Bulgaria and Turkey, and the latter's declaration of war led to Britain's annexation of Egypt for the duration of hostilities.

In Britain, under King George V, the Asquith Ministry had Kitchener as Secretary of State for War. He raised the Army's strength from seven to seventy divisions by 1916, when conscription was introduced, but he was drowned that year when H.M.S. *Hampshire*, carrying him on a visit to Russia, struck a mine. In the same year Lloyd George, who had organized the munitions, became the Coalition Premier for the remainder of the war. At the Admiralty, Churchill was succeeded in 1915 by Balfour, followed by Carson and Geddes.

On the Western Front, the initial German advance forced the British retreat from Mons but was held at the Battle of the Marne. Trench warfare with its unforgettable casualty lists then set in, and Rupert Brooke bravely wrote: ' Now, God be thanked Who has matched us with His hour, And caught our youth, and wakened us from sleeping . . . .' The Germans used gas at Ypres in 1915 and the British launched the first tanks at Cambrai in 1917. A final German bid threatened the Channel ports and Paris in the spring of 1918. Foch was put in supreme command, Haig leading the British troops as he had done since 1915; and the final Allied offensive through the Hindenburg Line began in July 1918.

On the Eastern Front the Russian advance was stopped by Hindenburg and Ludendorff at Tannenberg in 1914, but in 1916 Russia was able to launch a last offensive against Austria, who was simultaneously attacked by Italy on the Isonzo Front. In 1917, the Bolshevik October Revolution was followed by Lenin's capitulation to Germany. The release of the latter's troops was, however, by then matched by the arrival of United States divisions on the Western Front.

In overseas theatres there was the spectacular contribution of the British Dominions in addition to Canada's aid in Europe. The Australians and New Zealanders were at the ill-fated attempt to open a route to Russia through the Dardanelles in 1915 and in Allenby's successful advance on Jerusalem in 1917, followed by his final defeat of the Turks in October 1918, the opening of the Dardanelles, and the occupation of Constantinople. Indians were in the Mesopotamian campaign and after the loss of Kut the previous year reached Baghdad in 1917. There was participation in the Allied force in Macedonia, which forced the surrender of Bulgaria early in 1918.

In Africa, territories which bordered the German colonies raised forces to campaign against them. French and British forces soon took Togoland and the Cameroons; and the South Africans, under Botha and Smuts, overran German South West Africa. In East Africa where the *Königsberg* sheltered in the Rufiji River, the German defence held out until 1917. British naval supremacy ensured the sea communications for overseas operations after Sturdee had avenged the early loss of the *Monmouth* and the *Good Hope* at Coronel by defeating von Spee at the Falkland Islands, and after the *Emden* had been sunk by the Australian cruiser *Sydney*. Naval supporting fire was at call in coastal operations, particularly at the Dardanelles and by monitors on the Belgian coast; and a blockade of Germany was effectively enforced.

The German High Seas Fleet was contained by the Grand Fleet except for sporadic raids on the English coast, which preceded the main encounter at Jutland in 1916. Thereafter, the German Fleet's immobility was a factor in the mutiny of 1918, which hastened the German capitulation. After the Armistice, it steamed to surrender in the Firth of Forth and to internment at Scapa Flow, where it later achieved self-destruction by scuttling.

German submarine warfare developed in 1916 when the liner *Lusitania* was torpedoed. It became openly unrestricted by a German announcement of February 1917, and in April 875 000 tons of shipping were sunk. Largely at Lloyd George's insistence the convoy system was introduced, and by the end of the year the menacing shortage of food in England had been eased. Other measures were the defensive minefields in the Dover Strait and the Northern Barrage from the Orkneys to Norway, the scientific development of detection devices,[1] the use of *Q* ships—warships disguised as merchantmen—, and the naval raid to block the Zeebrugge and Ostend submarine bases on St George's Day, 1918.

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[1] See footnote [1] overleaf.

Aircraft were used for reconnaissance and artillery support. There were the several bomb-dropping raids on England by Zeppelins or single aircraft, and as a result anti-aircraft defences were brought into being.

In October 1918 when the Allied armies were advancing on the Western Front, President Wilson's Fourteen Points were under consideration, but the mutiny of the German Navy and the flight of the Kaiser hastened a German surrender and an armistice, which was in terms of total victory for the Allies. In the following year the Paris Peace Conference abandoned the Fourteen Points and alternatively set up the League of Nations. A major consequence of the Treaty of Versailles in June was the re-creation of Poland.

At home there was the rise of the Sinn Fein movement in Ireland, which attempted negotiations with the Germans, so that in 1916 Casement, on his return in a U-boat, was captured, tried, and executed. There followed the rebellion of Easter-week, the ruthless suppression of which alienated Ireland from England yet further. Late in 1918, the Education Act and the Fourth Reform Act were passed to give women, who had contributed much to the war effort, the right to vote at the age of thirty, which was reduced to twenty-one in 1928. In the winter of 1918 a devastating influenza epidemic swept through much of the world, and more persons died from that than from the toll of the war.

Exploration in Antarctica continued. The British Imperial Trans-Antarctic Expedition, largely financed by Sir James Caird but also with Government and some Royal Geographical Society support, had left East India Docks several days before war broke out, and on that day Shackleton had received a Union Jack from King George V. He sought an Admiralty decision and Churchill replied with the order to proceed. The story of the *Endurance*'s being beset and abandoned in ice, her crew's arrival and stay on Elephant Island, and Shackleton's boat journey to South Georgia has been vividly told in *Endurance*.[2] Shackleton's fourth relief expedition successfully reached Elephant Island in August 1916, and Davis in the *Aurora* rescued the survivors of the Ross Sea party at Cape Evans in January 1917, in which year the Colonial Office set up the Interdepartmental Committee on Research and Development in the Falkland Island Dependencies, which led in 1923 to the formation of the Discovery Committee.

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[1] In view of the later development of echo-sounding during the 1920's it is of interest that besides the development of a listening-hydrophone from the submarine signalling-apparatus used to locate lightships in fog from 1904 and of the indicator-loop based on the generation of a current in it by an iron vessel passing over it, there was mention of Asdics in Technical History and Index No. 7, *The Anti-Submarine Division of the Naval Staff*, July 1919. It described the connexion of a transmitter to a quartz plate transmitting vibrations at frequencies from 30 to 150 kc/s, which were projected in the form of a beam. The reception of an echo effect from a vessel's hull was on another quartz plate connected to a three-valve amplifier in conjunction with a receiver. Experiments had begun in June 1917, and by the end of the war seven ships were fitted and were obtaining promising results.

[2] A. Lansing, Hodder and Stoughton, 1959.

Departmental activity

The first four years of Parry's term of office were those of the 1914–18 war, and for them a detailed source of information, in addition to the annual reports, is Technical History and Index No. 22, *The War Work of the Hydrographic Department*. It includes some historical background and pays tribute to the early surveyors in its frontispiece. This portrays, side by side, two charts of Scapa Flow, one 'to show the Situation and Extent of Scapa Flow as a proposed roadstead for a Line of Battle Ships, most humbly presented to the Rt Honorable the Lords Commissioners of the Admiralty by Graeme Spence, late Maritime Surveyor to their Lordships, 1812', and the other a corresponding portion of the modern chart.

Parry's principal officers were Hardy as Assistant Hydrographer, Douglas, and from 1915 Nares, as Superintendent of Charts, Gibson as chief cartographer first grade, and from 1917 Underhill, with the new title Assistant Superintendent of Charts, Smith as Superintendent of Sailing Directions, Warburg in charge, and from 1917 Superintendent, of Tidal Work, Grant for Notices to Mariners, Barber as Chief Civil Assistant, and Llewellyn for Chart Issues, with the title of superintendent from 1917. Learmonth served in the Admiralty throughout the war as Captain Superintendent of Submarine Defences or, as the title became, Director of Fixed Defences.

The Navigation Department, formed in 1913 under Nelson-Ward, rejoined the Hydrographic Department as one of its branches in September 1916 with Webster as Assistant Director of Navigation. The Royal Naval Meteorological Service, formed in 1916 under Douglas, became a branch of the department in January 1918, with Glennie as superintendent, soon to be succeeded by Lieutenant H. D. Grant, R.N.V.R.

The personnel of the department increased from 61 in July 1914 to 367 in December 1918, the increase consisting mainly of temporary draughtswomen and female clerks. Naval assistants to Hydrographers increased from twelve to sixteen, in 1916 to twenty-five on the reamalgamation of the Navigation Branch with the Hydrographic Department, and in 1918 to twenty-six, plus twelve R.N.V.R. officers when the meteorological service became a branch. Cartographers fell from twenty to eighteen and draughtsmen from eleven to six, but temporary draughtsmen and draughtswomen numbered six and forty-five by the end of 1918, the first eleven of the latter joining in July 1916. The permanent civil staff only increased from thirteen to seventeen, in which there were five staff clerks and six in the second division; and it was the temporary women clerks beginning with two in August 1915 and increasing to 220 in December 1918 who swelled the civilian total, chiefly in Issues Branch. There were also three night-duty officers, of which one was Monro, the Professional Officer at the Board of Trade; the others were retired officers, working as revisers of Sailing Directions. Their services were no longer needed in January 1918 when other arrangements were made.

There were various fluctuations as members of the civil staff joined the forces, several to fall in action. The awards of honours for outstanding war service are given on page 316.

Before describing the wartime activity of each branch, the general lines on which the department's work was reorganized for war may be briefly stated. All extant publications were kept under revision as far as possible, but in the realization that any information on charts or in publications on sale had wide circulation and therefore could not be prevented from reaching the enemy; consequently, much new information was not inserted on Admiralty charts or given in Notices to Mariners—instead it was promulgated to the Fleet in Confidential Fleet Notices or by special charts. Defence of the Realm Regulations were invoked, as later described, in 1915 and more strictly in 1918 to ensure that no charts or publications found their way out of the country to an improper destination.

Chart Branch, which had one of the additional naval assistants with a secondary role in Operations Division for the purpose of buoy-laying, was mainly occupied in producing a large number of charts for war purposes. Fleet charts increased from 56 to 118 for rangefinder testing, general purposes, or special operations, often at the request of particular flag-officers, e.g. one from a survey by Garbett in 1917 of the Rufiji River, where the German ship *Königsberg* took shelter.

The prefix *X* had been used for diagrams on sale since 1896, but in December 1914 it was adopted for those not on sale, others being prefixed *D*. They were corrected by new editions when necessary. Their importance increased, e.g. one showed minefields in the Dover Strait, and at the end of 1917 there was a reclassification of other than *F* navigational charts into *X* non-Confidential without restriction on their issue, *Y* Confidential, and *Z* Secret with a severely limited distribution.

A total of 345 *X* charts, some so reclassified, were produced for commanders-in-chief, Vice-Admiral Dover, and the Operations, Intelligence, Trade, Anti-submarine, and Air Staff Divisions. The gnomonic projection was used (1916) for charts on which W/T direction-finding bearings of enemy submarines were to be plotted. There were charts of the world with 5-degree or 10-degree squares overprinted in red, others for bombardment at the Dardanelles or on the Belgian coast, for the Zeebrugge attack, or for coastal motor-boats. Some were reproductions of enemy charts. The largest was nine feet by seven, covering the Atlantic from the Faeroes to Gibraltar for the A/S Division, and the smallest, five by six inches, for sailing-barges and small vessels navigating through the mined Dover Strait. There was the Time-zone chart for the Board of Trade following the conference on timekeeping at sea, held at the Admiralty in June 1918. There were Air charts for the Admiral Commanding Aircraft; and one in 1918 was for the Director of Naval Intelligence as propaganda to speed up shipbuilding by showing scenes of naval actions, the tracks of naval armoured cars from Kola and Archangel to the Persian Gulf, and the routes of troop transports from Australia and America, to which country many copies of this chart were sent. At the end of the war there were charts for use by the Allied Naval Council in mine-clearance operations.

The *Y* charts totalled eighty, of which sixty had previously been *X* charts. There were squared charts for auxiliary patrol vessels to report their positions rapidly should enemy vessels be sighted, and in 1916 new editions were issued embodying changes in case copies had fallen into enemy hands. There were War-channel charts and charts of minefields or prohibited areas. There were Firing charts on which a ship could fix by sextant angles to selected objects, plotting them on overprinted curves of equal angle, and calculating the bearing and distance of the target from grid readings; and these were used by monitors, flotilla leaders, and others in Dover Command.

The *Z* charts numbered forty-one. They were used to show actual lines of mines on the East-coast and Northern Mine Barrages, and submarine patrol areas, which, however, were withdrawn as being too dangerous in the event of their falling into enemy hands by capture. There were charts of convoy rendezvous positions (1917) prepared for the Director of Mercantile Movements, and there were some of the Mediterranean to show the squaring known to be in use by the Germans.

Finally, there were the *O.X.O.* charts, instigated by the Director of Naval Intelligence, of which two sets of some thirty charts and diagrams were produced. One set was made in the autumn of 1914 when a trawler dredged up German material after the Heligoland Bight action of 28 August, the other was a reissue after additional material had been recovered from the German submarine *UC41* in the winter of 1917–18. The printing of the first set was done at the Ordnance Survey, Southampton, for security reasons before the Admiralty Secret press was set up.

Air charts were first produced in December 1914 in strip form for the use of coastal patrolling airships and seaplanes. In June 1917 when some pilots in the R.N.A.S. were preferring to use cuttings of Admiralty charts, it became obvious that ' the needs of the airman were no more likely to be satisfied by an Admiralty chart than the needs of the mariner could be by an ordnance map '. The result was the production of charts sixteen inches square on Mercator's projection and scales of one inch to three and ten nautical miles for coastal and general use respectively. Admiralty charts were used as the basis, land was coloured green, prominent objects were clearly shown with churches having spires and towers differentiated, and the water-work was greatly simplified.

In 1918 there were experimental *Z* Air charts for position-finding by directional W/T bearings from apparatus in an airship. The position lines of such bearings being spiral curves meant plotting difficulties, and an attempt was made to plot isoazimuthal curves on selected W/T stations. The problem was discussed in the Technical History together with the known German usage; and it was not fully resolved at the end of the war. Air charts were supplied by Issues Branch to airship and seaplane stations, aircraft-carriers, and the like; and Notices to Airmen were prepared in the department. The Air Ministry, after its formation in April 1918, provided the distribution list.

Submarine or *S* charts comprised a group of fifty-nine charts covering home waters, the North Sea, and Kattegat. They were produced during the war to provide as much information as possible on the nature of the bottom. Colour overprinting was used to show sand, mud, and clay in blue, shell, gravel and shingle in light red, and rock, boulders, stones, and chalk in dark red. Two more charts showed the approximate positions of wrecks in the North Sea. Issues were made to surface ships as well as submarines, since they provided a guide to the bottoming-berths used by enemy submarines.

There were also five *TS* and nine *DS* charts, the former showing subsurface tidal streams in the North Sea, the latter the density changes at different times of the year in the North Sea and Kattegat. ' Before the issue of these charts many curious and, at the time, obscure anomalies were experienced by our submarines unable to sink or rise without taking in or discharging an unusual amount of water ballast.' They were produced in 1916; and in 1917 a pamphlet—*Hydrographic Notes on Submarine Navigation*—was published. The annual reports of 1915–18 pay special tribute to the voluntary services of Dr G. H. Fowler, ' with his exceptional knowledge of oceanographical science ', who with Mr J. O. Borley, lent from the Board of Agriculture and Fisheries, compiled these charts.

Telegraph charts had for many years been maintained in manuscript on information from cable companies and other sources, which was treated as secret. There were about 700 charts and plans kept in duplicate. One set was compiled in black only in order that it could be reproduced photographically, which was in fact done during the war for a folio of 38 charts of the eastern shores of the North Atlantic. Issues were selectively made to commanders-in-chief and H.M. ships, much information being supplied by the section to Admiralty departments, the War Cabinet, the War Office, the Air Ministry, and, at the end of the war, to the Peace Conference.

The Telegraph Chart Section also handled W/T information. Pre-war commercial stations were shown on the three Telegraph charts of the world, which showed communications facilities but not the run of the cables. During the war the number of stations so increased that W/T charts were compiled for the war zones. Prior to the institution of the W/T Board in 1923, the department was the source of information to many Government departments. The senior chief cartographer directed the work of the section, its two draughtsmen being augmented by three draughtswomen during the war.

The output of ordinary navigational charts fell, so that the comparative figures for 1913 and 1918 were: new charts, fifty and seventeen; charts improved by the addition of plans, forty-five (sixty-nine plans) and twelve (fifteen plans); new editions, 312 and 142; large corrections, 815 and 730; small corrections to plates 9 309 and 6 044. On the other hand, small manuscript corrections to chart stocks rose from 169 064 in 1913 to 408 425 in 1919.

Printing continued at Malby's, which became a controlled establishment in 1917, and the Chief Civil Assistant, Barber, acted as Admiralty Supervisor at £200 per annum. Confidential and Secret charts were, however, printed at the Ordnance Survey, Southampton, until 1917, when the Hydrographer had a Secret press in the Admiralty. Methods of printing from the copper plates or from transfers to lithographic stones were increasingly supplemented, for greater rapidity, with photolithography and with the Vandyke process, in which the original drawing could be used direct. For Air charts there was the acid-blast process, which used copper plates covered with a sensitive film and etching with acid.

The numbers of charts printed for the Navy and Government departments increased from 481 376 in 1913 to 2 357 334 in 1918, while those printed for sale decreased from 407 960 to 241 121. The corresponding value and net value in 1918 were £339 330 and £25 035.

There were subsidiary chart-production and printing facilities in the eastern Mediterranean and at the Survey of Egypt, Cairo. The former were sent out in the *Endeavour*, Edgell, with a cartographer, Hardie, as a lieutenant, R.N.V.R., at the request of the Vice-Admiral, Eastern Mediterranean, and came under the orders of his staff officer (H), Douglas. The equipment consisted of one DE and one ½ DE hand litho-presses and one DE vandyking frame, to which letterpress machines were added in 1916. The staff of printing tradesmen was lent from the Ordnance Survey and increased from three in 1915 to twenty-two in 1917. The presses, first put ashore at Kephalo Harbour, Imbros, were transferred with Viney in charge to Mudros when the Gallipoli Peninsula was evacuated, and the *Endeavour* had left, in May 1916, and were in August 1917 removed to Malta. Local operational charts and Notices were produced and, later, many reports by letterpress for the Commander-in-Chief. In November, Hardie took a section to work at Constantinople, and some personnel went in the flagship to Sevastopol. Mine-clearance and routing charts were produced there before the section returned to Malta and thence to England with the remainder of the staff in March 1919.

At the Survey of Egypt, Cairo, where ' the officials occupy a high place amongst those concerned with the science of map production ', most valuable assistance was given from early 1917 in the production of local surveys and Notices under Haselfoot, staff officer (H) to Vice-Admiral, East Indies and Egypt. Haselfoot, who was assisted by Mason, an acting cartographer serving as a lieutenant, R.N.V.R., was succeeded by Bright Barton from October 1917 until June 1919. The locally developed facsimile-reproduction method known as ' douglagraphing ' was used in addition to photolithography.

The Chart Issues Branch was, on the outbreak of war, in two rooms on the second floor of the old building under the portico, but soon moved into three on the second floor of North Block and two on the floor above. Other rooms were gradually taken over until, in 1915, the branch moved to Randvoll House, Charing Cross Road, which it shared first with the R.N.A.S. It later acquired the adjoining Ancaster House and finally requisitioned three large shops in Shaftesbury Avenue. The staff increased from 18 in 1914 to 175 in 1919, the additions being mostly temporary women clerks; and in 1917 its head, Llewellyn, became the first Superintendent of Chart Issues.

The rise in the numbers of charts printed and issued has already been quoted. They were ordered as required from Malby or the Admiralty Secret press and made up into folios and sets while books were supplied from H.M.S.O. and Notices from Wymans in accordance with branch instructions. Besides issues to H.M. ships there were those to ships of the Allied Powers, such as the U.S. battle squadron, which joined the Grand Fleet in 1917. Two special sets were made up for auxiliary patrol vessels from some twenty special folios, each covering an area of operations, and two special folios containing small-scale charts to permit navigation from one patrol area to another.

An increasing amount of merchant-shipping tonnage was gradually being taken over by the Admiralty and the Ministry of Shipping. The charter condition was such that by the end of the war nearly ninety-five per cent of British shipping was using Admiralty charts on loan from Issues Branch. From 1917, merchant ships in convoy were supplied with special sets embracing the Atlantic routes and the assembly or dispersal ports.

During the war, chart depots were set up at Rosyth, Haulbowline, Cardiff, Newcastle-upon-Tyne, Esquimalt, and Halifax, Nova Scotia, in addition to those existing at Portsmouth, Sheerness, Plymouth, Pembroke, Gibraltar, Malta, Hong Kong, Simonstown, and Bermuda, and that at Sydney under the Australian Navy. There were also sub-depots under local officials at Port Said, Aden, Bombay, Colombo, Singapore, Port Stanley, and Kingston, Jamaica, but only at Colombo were the charts kept corrected. Several depots were under trained civilians rather than naval officers. Telegraphic reports were instituted to speed the replacement of stocks from home.

These details give some idea of the magnitude of the task of Issues Branch. On the outbreak of war the meeting of the demands of the Reserve Fleet entailed several weeks of day and night work, and Parry personally took a hand, in his shirt-sleeves, during the packing of charts in the Admiralty corridors.

Chronometer supplies to the Fleet were discussed in a historical note in the Technical History, which indicated how the Royal Observatory, Greenwich, had become pre-eminent as a testing-place for chronometers, produced mainly in England—the observatory's position on the meridian provided testing by star transits without any possibility of a longitude error. Chronometers of various makes were kept there for trial or sale, and a decision in 1818 that the Hydrographer should make purchases and supplies for the Fleet through the Astronomer Royal could be attributed in part to Hurd's being Secretary of the Board of Longitude and then Superintendent of

Chronometers. The availability of chronometers to the Navy had, therefore, always been assumed, small stocks being held in chart depots.

In 1914 the established allowances were: capital ships, three chronometers and one hack-watch; torpedo-boat destroyers, one chronometer and one hack-watch; torpedo-boats, one chronometer-watch and one hack-watch. The rapid increase in the number of naval and merchant vessels meant that stocks became exhausted; the Allies were dependent on supplies from England and mass-production methods could not be employed.

At the Hydrographer's request in August 1916 the Board of Trade prohibited exports of chronometers, and in May 1917 he drafted the Admiralty order for a census, which confirmed the serious shortage. In August he obtained an order under the Defence of the Realm Regulations, which classified chronometers as war material, and this was published in the press. It led to the placing of makers on the Schedule of Protected Occupations and also to the provision of information on the requirements of Government departments and shipping companies, which thus ensured that supplies would be made to British and Allied shipping where most needed. Special arrangements were made in 1917 with the U.S. Shipping Board and with the Japanese Government through the Commission Internationale de Ravitaillement. In 1918 purchases of pocket-watches as a substitute for hack-watches were made in America, and also of some so-called chronometer-watches, chiefly from the Waltham Watch Company. Some purchases were made in France and Switzerland. The expenditure on chronometers and watches increased from £4 016 in 1914 to £17 804 in 1918. A number of privately-owned chronometers was lent to the Admiralty during the war, and the lenders were duly thanked when the chronometers were returned in December 1918.

The sale of charts and publications through the Admiralty chart-agent, Potter, and his subagents came under increasingly strict regulations to prevent their reaching enemy hands, either directly or through neutral countries. At first it was thought sufficient to instruct that the case of any doubtful purchaser should be referred to the Admiralty, but by November 1914 more detailed instructions were considered necessary. Even then they did not cover commercial charts or blue-backs, and in June 1915 fuller instructions were issued to the Admiralty agent and commercial distributors. In September 1915 the instructions, invoking Regulation 18 of the Defence of the Realm Regulations, required that a certificate, retained for inspection, be signed before purchase by any bona fide applicant in the United Kingdom or subjects of Allied Powers. The postage or shipment of any publications out of the United Kingdom needed a permit from the Hydrographer for presentation to the postal or Customs authorities. In September 1918 a consolidated order was published by the Admiralty under Defence of the Realm Regulations 24 and 24b which concerned charts and hydrographic publications of all descriptions. The Order remained in force until December 1918. The Technical History prints the various orders and acknowledges the valuable help given by the postal and Customs authorities in ensuring that no package of charts and the like left the country uncensored or not in compliance with the regulations.

Notices to Mariners in 1913 were averaging about six a day, having become well established as a means of notifying, gratis, to all holders of Admiralty charts and publications a large proportion of the information needed to keep them up to date. Details of lesser importance were inserted on the chart plates without notification, and affected the copies subsequently printed. Notices were issued daily to home chart depots, the chart-agent, the Board of Trade, Trinity House, and certain naval recipients. For the Fleet there was a weekly edition in eight sections, of which two announcing new publications were discontinued during the war; but on occasions of importance a Notice marked '(H)' was dispatched on the day of issue. If there was extreme urgency, a telegram was drafted and sent to Military Branch for transmission by the Admiralty wireless. From 1913 Notices not only quoted the authority but also the number of the Hydrographic Department paper on which action was taken.

There were temporary or preliminary Notices for corrections to be made in pencil and a list of those in force was published in the weekly edition; and there were Fleet Notices affecting Fleet charts only. The Notices to Mariners Officer drafted the Notices, and the system in use at that time whereby proofs were checked by an independent officer and again by the Assistant Hydrographer has continued to the present day.

Conditions of war caused a diminution of Notices to Mariners (prefixed Admiralty from July 1915 to distinguish them from those of the Board of Trade, Trinity House, and others) by reason of the cessation of surveying by nations at war and of the need to suppress information of value to the enemy. There were, however, temporary War Notices which detailed changes in navigational aids announced by Allied, neutral, and enemy Powers; and Defence of the Realm Act Notices on U.K. traffic regulations, which, in 1915, were issued under the provisions, and with the authority, of the 1914 Defence of the Realm Regulations.

Fleet Notices to Mariners provided the means of promulgating information withheld from the public, and the rapid growth in their numbers necessitated the addition of a naval assistant to help the Notices to Mariners Officer. Two examples of the problem were: Firstly, many aids to navigation were withdrawn at the beginning of the war but remained on the charts, and not until 1916 was it decided that the strategical advantage of suppressing this information was outweighed by its inconvenience—the consequent deletions caused much work in depots and ships and also on the chart plates, although no public Notice was issued. No new aids were, however, inserted on chart plates during the war. Secondly, new wrecks were passed over in silence as far as the public was concerned in order to withhold from the enemy their exact location and marking, but in 1918 the increasing number of wrecks made easier the decision to promulgate the information for the benefit of Allied shipping, even at the risk of advantage to the enemy.

A Fleet Notice, No. 59, of 1914, announced details of the new use of Fleet Notices to provide a method whereby changes in aids to navigation could be placed on the chart plates and also inserted on Admiralty charts in Government use without the issue of an ordinary Admiralty Notice. The method had practical disadvantages owing to the extra work thrown on holders of chart sets, which would otherwise have been done in the department or depots, but it provided a much needed avenue whereby confidential information could be conveyed to those most requiring it without divulging it to the general public.

Various steps were taken to simplify this extra work by providing a home-waters edition for the enormously increased number of vessels employed in these waters by the Admiralty, periodically listing the temporary Notices in force, publishing annual summaries, grouping information in geographical areas, and boldly indicating additions or deletions in reissues of those lengthy Notices remaining in force. For the benefit of fleet auxiliaries not issued with the Confidential Fleet charts or Notices, an issue of selected information was promulgated from 1915 in Fleet Auxiliary Notices. After the Armistice, Mine Warnings to Mariners were instituted and published periodically from data supplied by the International Mine Clearance Committee. Some statistics were:

		1914	*1916*	*1918*	*Printed 1918*
Admy N. to M.	*Black*	1 869	1 521	1 616	28 119 037
Tempy War and D.O.R.A.	*Black*	79	174	300	—
Wreck N. to M.	*Black*	143	103	296	—
Fleet Notices	*Red*	123	691	855	3 206 250
Fleet Auxiliary	*Blue*	—	364	521	4 063 800
Mine Warnings	*Green*	—	—	34	950 000

The approximate number of Notices of all kinds printed and issued by the department from 4 August 1914 to 31 December 1918 was 128 126 200.

In the department, it was found necessary from August 1916 to keep a set of charts for reference purposes of the British Isles and the Netherlands, and the Belgian and north French coasts, corrected for information promulgated in the various Notices including the temporaries, and there was another set for wreck data. The Naval Staff found similar need of a corrected set for operational purposes, and an officer, Glen,[1] was added to the naval assistants in the department for this purpose. In June 1918 the First Sea Lord, Jellicoe, who had specialized in navigation, well appreciated the need. The appointment was revived in the 1939–45 war and has continued with the title Officer-in-Charge, Staff Charts.

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[1] Lieutenant-Commander G. C. Glen, D.S.O., R.N., a specialist (N) officer, had been in minesweeping operations. When the war ended he became secretary of the International Mine Clearance Committee, which continued to act until 1929. He was again Officer-in-Charge, Staff Charts, in the 1939–45 war, serving as a commander.

Admiralty Lists of Lights and Time Signals continued to be in nine volumes and included time signals from 1912. Corrections to them formed Part VIII of the weekly edition of Admiralty Notices to Mariners from 1913. On the outbreak of war, a cautionary Notice about the extinguishing of lights was issued, and thereafter no changes were made in the Light Lists for information issued confidentially. Parts I and II became increasingly valueless, and in March 1918 it was decided to collect and systematize the information promulgated in Fleet Notices, which resulted in the appearance of a monthly War Supplement printed in red. The supplement used the same format and numberings as the Light Lists, with extra space for explanatory remarks, but was for Part I, the British Isles, only. The introduction of British summer time in 1916 was notified in Admiralty Notices to Mariners as was the adoption of G.M.T. by Ireland, also in 1916.

Sailing Directions, in some sixty volumes, were also uncorrected for confidentially issued information. Their revision continued to be at intervals of about ten years, with annual supplements issued for most of them. For the latter purpose, an additional naval assistant was added in 1916 to the staff of the superintendent and two officers, while the male clerk was succeeded by two women in 1916, reduced to one in 1917. Some of the retired officers acting as revisers in their homes were mobilized, which meant shortage of staff. One entirely new book was produced during the war for the Antarctic in view of the growing importance of the South Shetlands as a whaling-station, and of the enlarged area declared to be a dependency of the Falkland Islands.

Owing to the erratic demands of the war years it was found economical to keep many volumes and all the supplements permanently set up at the printer's. Also during the war, one of the night-duty officers was able to catalogue topographical sketches and plans, many of early date and unique interest, which were formerly not easy of reference. The Jacketing Officer continued to select papers for jacketing, although a central registry was begun during the war and filed papers of date subsequent to 1916.

A need for an index of names on Admiralty charts, since all do not appear in Sailing Directions, was emphasized by examples of the inability to identify names mentioned in operational signals to the Admiralty. The compilation of an *Index Nauticus* was begun by two temporary draughtswomen in 1917, increased to four for a time in 1918. The coasts of the British Isles involved some 100 000 names. The hope that it could be extended to all parts of the world did not last, and only one edition was published in 1920.

The Tide Tables were undergoing a complete revision, commenced early in 1914, so as to enable the rise and fall of the tide to be more easily followed. Predictions were mainly calculated in the branch, which had an officer-in-charge, one clerk, and the part-time help of the Instruments Officer. The

SURVEY AND CHART OF ALEXANDRIA APPROACHES, 1920

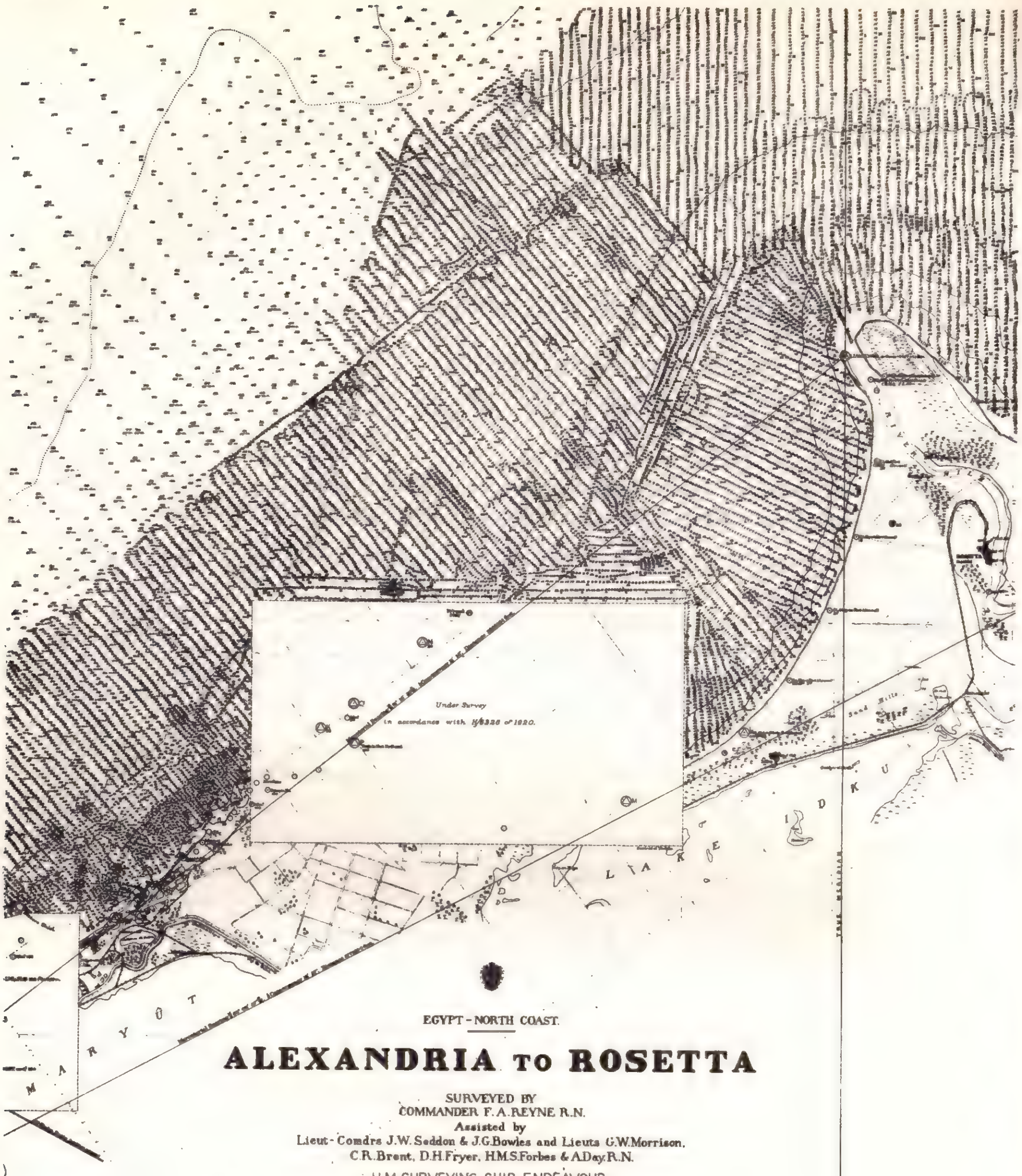
XII *Alexandria to Rosetta*
XIII *Alexandria and Abu Qir Bay*

The following two plates are reproductions of a fair drawing of a survey made at the close of the period covered by this history and an Admiralty chart published from the results of this fair drawing.

The drawing, or 'fair chart', executed by the author on his first survey, employed various coloured inks and washes. It shows a typical arrangement of the lines of soundings run by the ship and her boats. The triangulation network and its orientation can also be seen.

The corresponding published chart illustrates the cartographic art in, for example, the selection of soundings, the treatment of the fathom lines, and the introduction of a compass rose. The copper plate of 1938 is still in use although it has been subjected to numerous corrections to keep the chart up to date.

The space available and the purpose in view have dictated which parts of the originals should be used and their reduction, of the order of 2·5: 1, is slightly dissimilar.



EGYPT - NORTH COAST.

ALEXANDRIA TO ROSETTA

SURVEYED BY
COMMANDER F. A. REYNE R.N.
Assisted by
Lieut-Comdrs J.W. Seddon & J.G. Bowles and Lieuts G.W. Morrison,
C.R. Brent, D.H. Fryer, H.M.S. Forbes & A. Day. R.N.

H M SURVEYING SHIP ENDEAVOUR.
JUNE - NOVEMBER 1920.

A△ (Ras el Tin Lt. Ho.) Lat. 31° 11' 41·9" N. Long. 29° 51' 36·91" E.
Magnetic Variation 1° 36' W.
Figures in red denote heights in feet above the Mean Level of the Sea.
SOUNDINGS IN FATHOMS

Tidal Information

Place.	H.W.F.&C.	Range.	Datum to which Soundings are reduced.
Alexandria	X^h 05^m	1 Foot (Approx)	5 feet below the bench mark on the extreme end of the Western Jetty at the entrance to Arsenal Basin, or 0·75 feet above the zero of the Mareograph at Alexandria, or 0·36 feet below Mean Sea Level.

Natural Scale - $\frac{1}{100,000}$

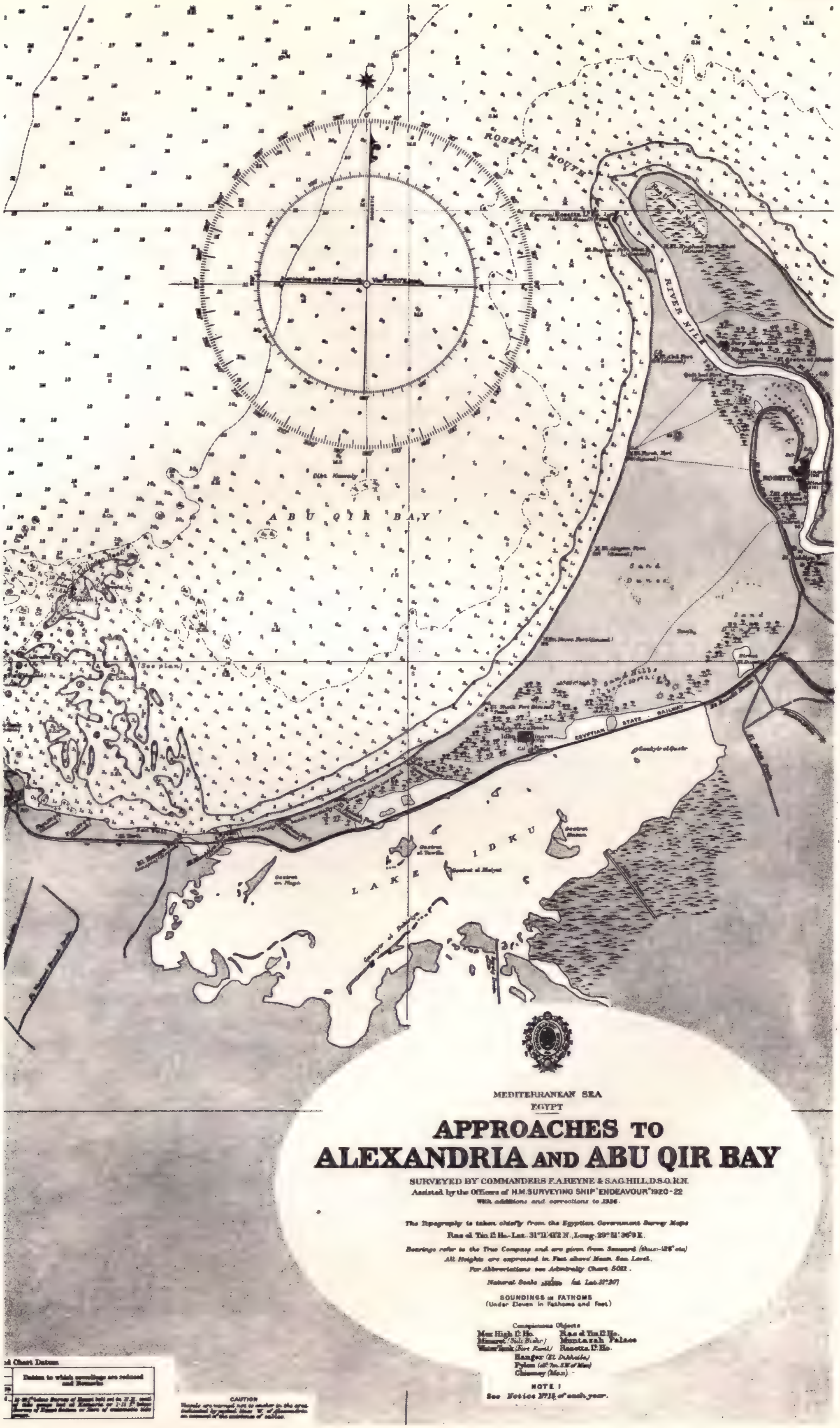
List of conspicuous objects.
One large house with two cupolas, at Montaza.
Minaret at Sidi Bishr. Rosetta Light House.
Ras el Tin Light House. Mex High Light House.
Tank in Fort Er Raml. Abukir.

Soundings and Coastline in Red from a Survey by Commander S. A. Geary Hill, R.N., and Officers of H.M.S. Endeavour, August & September 1921.

Approved

H. Reyne.

Commander
in Charge of Survey


ROSETTA MOUTH
RIVER NILE
ROSETTA
ABU QIR BAY
Dist. Kawaly
(See plan)
Sand Dunes
Sand
Sand Hills
EGYPTIAN STATE RAILWAY
LAKE IDKU
Caution
Datum to which soundings are reduced and Remarks
Chart Datum
CAUTION
Vessels are warned not to anchor in the area indicated by pecked lines W. of Alexandria on account of the existence of cables.

MEDITERRANEAN SEA
EGYPT

APPROACHES TO ALEXANDRIA AND ABU QIR BAY

SURVEYED BY COMMANDERS F.A.REYNE & S.A.G.HILL, D.S.O. R.N.
Assisted by the Officers of H.M.SURVEYING SHIP "ENDEAVOUR" 1920-22
With additions and corrections to 1936.

The Topography is taken chiefly from the Egyptian Government Survey Maps
Ras el Tin Lt. Ho.-Lat. 31°11'42.2 N., Long. 29°51'36.9 E.

Bearings refer to the True Compass and are given from Seaward (thus:-126° etc)
All Heights are expressed in Feet above Mean Sea Level.
For Abbreviations see Admiralty Chart 5011.

Natural Scale [illegible] *(at Lat. 31°20')*

SOUNDINGS IN FATHOMS
(Under Eleven in Fathoms and Feet)

Conspicuous Objects

Mex High Lt. Ho.	Ras el Tin Lt. Ho.
Minaret *(Sidi Bishr)*	Montazah Palace
Water Tank *(Fort Raml)*	Rosetta Lt. Ho.

Hangar *(El Dekheila)*
Pylon *(abt. 7m. S.W. of Mex)*
Chimney *(Mex)*

NOTE !
See Notice No. 15 of each year.

latter was not available from the end of 1915, and in November 1917, when the officer-in-charge, Warburg, became a superintendent with an allowance of £100, he had a naval assistant and a second clerk added to his staff. The number of ports for which predictions were given in Part I increased in 1918 to fifty-nine, of which twenty-eight were in the British Isles. In 1918 Part II, with the semi-permanent information, was bound up as a separate volume, and in the same year an abridged edition was published for home waters.

Additional information for the Fleet was at first given in Fleet Notices, but in December 1914 it was assembled into *The North Sea Handbook*. Then, in 1916, much unpublished data for the north coast of Russia and the White Sea became available and was promulgated in *The European Arctic Handbook*. The handbooks were reissued biannually and were combined into one in 1918. Besides the tide and tidal-stream information, times of sunrise and sunset, twilight, moonrise and set, and distance tables were included.

Predictions for German ports presented difficulty. At first there was material to make them by the harmonic method, but despite scientific opinion this method had serious errors. Later, captured German data were used, together with the equation method, which had been worked up by Tidal Branch [1] with excellent results. Special information was supplied for operational use by minelayers, minesweepers, and the like, and the customary provision of data was made to the Treasury Solicitor in cases of marine casualty.

Meteorological information for the Fleet was provided by the Meteorological Office before the war, the Hydrographic Department acting as the Navy's traditional link. During the war, more detailed and local information was necessary, much of it for operations demanding secrecy. In 1916 a small section of the R.N. Air Department was set up under Captain Lord Dunboyne to meet R.N.A.S. needs, but at the request of the Director of Air Services it was transferred to the Hydrographic Department in May 1917. The section then became the R.N. Meteorological Service, with Douglas as its director, and it was remodelled on the basis of observations by trained personnel at airship and seaplane stations, which included upper-air data from pilot-balloon ascents four times a day, previously made only from a few meteorological observatories. Forecasts increased in numbers and accuracy, and in some cases a more extended weather-outlook became possible.

By January 1918, the Admiralty staff numbered seven officers and eight women clerks and draughtswomen, and there were fifty officers and ratings at R.N. air stations. Glennie succeeded Douglas as director in February. Then, soon after the Air Ministry was formed in April 1918, discussions with the Admiralty ended in a transfer of the service to it in August, but for naval purposes there was an Admiralty meteorological service as a branch of the Hydrographic Department. Lieutenant H. D. Grant, R.N.V.R., was superintendent and had six meteorological officers. Routine reports and forecasts, with special issues for naval operations, were supplied to naval recipients. The Admiralty service also undertook the supervision of monthly Meteorological charts of the North Atlantic and the Mediterranean, and monthly moonlight diagrams for the Services.

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[1] See the *Geographical Journal*, May 1919.

The return of peace saw increasing numbers of reports from ships in the North Atlantic, and W/T weather-bulletins were transmitted twice daily from Cleethorpes and Poldhu W/T stations. Plans to extend this service to all parts of the world were put in hand, assistance in the organization being given by the Admiralty's meteorological service.

Instrument development and supply were the subject of Technical History No. 12, which opened with a description of the Hydrographer's responsibility for supplying surveying ships and chart depots and expeditions of exploration. It remarked that there had been little change in the instruments in use between 1860 and 1913.

During the war, C. M. Gibson being the Instruments Officer, there were developments of the sextant in particular, in order to provide rapid reading or to use an artificial horizon in kite-balloon rangefinding. In 1916 there was the Douglas/Appleyard (Commander R. Appleyard, R.N.V.R.) sextant, which allowed a reading without removing the eye from the instrument; and it had a secret Admiralty patent in Appleyard's name, being made by Hilger. In the same year there was the Bosanquet (Commander H. T. A. Bosanquet, R.N.) attachment, in which a rack on the index bar operated from the arc, also to give a direct reading. It was considered inferior to the Douglas/Appleyard sextant but was also patented and made by Cary, Porter.

For an artificial horizon there was an attachment designed by Professor H. F. Newall, F.R.S., of the Cambridge Solar Physics Observatory. It made use of a pendulum, but owing to the complications involved was never satisfactorily completed. There was an alternative using a liquid horizon by M. Fave, French Ingenieur Hydrographe en chef, which was tested in 1917. It was not effective when there was any motion on the observer's platform but was considered a step forward to a better design of marine artificial horizon.

Appleyard also produced a kite-balloon height-indicator using an aneroid barometer and a time/speed/distance dial. Douglas invented a range-dial using a diagram, a diagram for the distance of an object using the angle from the horizon to the object to help merchant vessels in anti-submarine defence, plotting-boards to evaluate instrumentally the bearings of several observers into ranges for use by defence monitors at Lowestoft, Yarmouth, and Middlesbrough, a diagram to give the distance and bearing of a target from differences of latitude and longitude on the Belgian coast where chart distortion gave inaccuracies, and a diagram to give the height of an aircraft from an angle of elevation and horizontal distance. The last was used in air raids on London and an aerial position-finder developed by the Metropolitan Observation Service was improved in conference with Parry, Douglas, and S. Porter of Cary, Porter. It used two or more reports from observers with an adapted transit-theodolite. Haselfoot invented an artillery clock and deflection-indicator used first on the Palestine coast and later by the Dover patrol, to assist the evaluation of aircraft-spotting corrections.

Colour-filters were supplied to the Fleet late in the war after testing by the *Daisy* and the *Esther*, who also tested a Fave automatic tide-gauge using bourdon tubes, which provided promising results. Lastly, the first astrolabe à prisme was purchased in 1916 through the Royal Observatory for astronomical observations by surveying ships. It had been designed in France in 1905 and had the advantage of only one instrumental constant, the angle of the prism. It was sent to the *Endeavour* for trials in 1918.

Supplies of instruments increased greatly during the war, and 505 sextants were purchased—nearly three times the number of the previous four years. Many were used for minesweeping, for which officers were trained at the Harwich base. Costs of repairs also increased, and after the Hydrographer had cited the United States Hydrographic Office's experience of saving twenty per cent by effecting its own repairs, an instrument mechanic was lent from the R.N.A.S. to the Hydrographic Department in August 1917, and the post became established.

Navigational matters referred to the department increased greatly in number, e.g. cases of collision, grounding, salvage, anchor and cable losses, the development and defences of Admiralty harbours, and so on. As stated on p. 253, the Instructions for the Hydrographer were amended in July 1916 to make him again responsible to the Board, with the assistance of an Assistant Director of Navigation. A year later, a proposal for reverting to a separate navigation department was not agreed, but in 1918 Parry, with the First Lord's approval, set out proposals to increase the Director of Navigation's responsibilities, saying that it was essential to lay down the division of work in a clearer manner. New Instructions acknowledged the increased responsibilities, and the prefix Assistant was dropped.

The Hydrographer was still adviser to the Board on all navigational matters, assisted by a Director of Navigation, but the latter was responsible to the Board for the items specified in his Instructions. It was made clear that in the Hydrographer's absence the Assistant Hydrographer was primarily responsible for the work of the department, but that the Director of Navigation would act generally for the Hydrographer in the specified navigational matters. All seamanship questions came under the Director of Navigation by a Board Order of March 1919. Pilotage was compulsory at defended ports during the war by a Defence of the Realm Regulation drafted in consultation with the Board of Trade.

The Hydrographer was consulted by the Board on the matter of territorial waters. When, in 1918, he saw proofs of a handbook produced by the Foreign Office Historical Section, he agreed with Naval Law Branch that it would be best to avoid a conference and insist on a three-mile limit. (The Admiralty had consistently argued for a reduction of territorial waters as far as possible.)

It would be a great advantage to have the matter decided but this was too much to hope for, and some consistency in British ideas was as much as could be expected at that stage.

After the war, the department quickly returned to its normal practices; not that there had not been advances during it. For instance, cartographic styles were further standardized and clarified during the Parry period when Gibson was chief cartographer. Chart 2583 in June 1915 was an example of two ½ DEs side by side, one of Deer Sound, Orkneys, and the other of its approaches on a smaller scale. Hill-work used ' smoke shading '; there was a list of conspicuous objects; and tabular tidal information. There was a true compass rose outside a magnetic one, which was in degrees as well as points.

For the year 1919, the last recorded in this work, statistical figures were: new charts, fifty-eight; fifteen charts improved with the addition of twenty-one plans; new editions, 234; large corrections (still not involving cancellation), 1 134; small corrections to plates, 6 488; manuscript corrections, 408 425; Notices to Mariners, 2 311; Fleet Notices, 303; Mine Warnings, 292; Notices to Airmen, 176. Charts printed for Navy and Government departments, 1 373 146, value £254 457; charts printed for sale, 735 325, net receipts £117 202. In 1920 the number of navigational charts in the catalogue was 3 546.

The business and organization of the department was set out fully in September 1917[1] in response to an office memorandum aimed at defining the Admiralty's departmental organization. It included a nominal list of officers and their duties, there being then nineteen naval officers exclusive of the Navigation and Meteorological Branches. Under ' Business ', there was an item on ' Territorial Waters and Rights ', which had not been mentioned in the current Instructions for the Hydrographer and on which his comments were increasingly sought.

Post-war reorganization was considered in April 1917, and a year later an Admiralty Reconstruction Committee was set up. The Hydrographer provided a list of problems. It included proposals to acquire Malby's business (this was not the first time it had been suggested[2]), to take over sales from Potter and the rights in the blue-backs, then in the sole hands of Imray, Laurie, Norie, and Wilson. A building should be provided to house these activities and chart issues under one roof on the outskirts of London and with good rail access. There were proposals to copyright Admiralty charts and make the Admiralty the sole producers, which was coupled with suggested legislation for making the use of Admiralty charts compulsory in all British ships. There was the future of chart-and-chronometer depots and of the overseas printing and sales organization.

Afloat, there was the reconstitution of the surveying service and the arrangement for surveys of colonial waters. In the upshot, only the last item was considered by the Reconstruction Committee, and other items were dealt with interdepartmentally as will be described. The Navigation Branch was concurrently concerned with the re-establishment of the Navigation School and the future selection of officers for (N) appointments.

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[1] File H.D. 2659/17

[2] See pp. 261 and 262.

The post-war staffing of the department occasioned several returns of the numbers borne. In October 1918 the Hydrographer said that none of the naval officers could be replaced by officers with less experience, and in March 1919 he considered that nineteen were required, i.e. the Hydrographer, Assistant Hydrographer, Superintendent of Charts and four assistants, Superintendent of Sailing Directions and one assistant plus two for revising supplements, Superintendent of Tides and one assistant, Light Lists Officer, Notice to Mariners Officer and two assistants, Instruments Officer and Special Investigations Officers. A small committee of the Hydrographer, two Assistant Secretaries, and representative of Civil Establishments Branch discussed the matter, Parry in May 1919 stressing the need to make a serious attempt to wipe out Chart Branch's arrears, which had been carried over from before the war. He thought that a bigger staff than that during the war would probably be required indefinitely and only Chart Issues Branch's numbers were being reduced during the reconstruction period. However, Navy Estimates for 1919–20 show that the establishment of naval officers on hydrographic tasks was set at fourteen, although from time to time there were additional temporary appointments for special purposes.

These Estimates showed that the cost of the department and surveying service was £149 407 or nearly double that of pre-war. Details were: Hydrographer, £2 100; Assistant Hydrographer, £1 434; Superintendents of Sailing Directions, £1 144, of Charts (a commander) £988, of Tidal Work £925; nine naval assistants, £7 794. Naval assistants received full pay plus a lodging allowance of £160 and the superintendents' allowances were £100. Improved rates of pay and allowances were the result of the report of the Jerram committee and were recorded in A.W.O. 3174/19.

The civil staff figures were: one chief cartographer first grade, with title of Assistant Superintendent of Charts, £600 (maximum); two chief cartographers second grade, £500; thirteen cartographers, £400, of which four were at present in lieu of eight draughtsmen; one Chief Civil Assistant, £700 plus £200 as Admiralty director of Malby's; three staff clerks, £450; and a total of 320 subordinate professional and technical grades, clerical staff, packers, and messengers. For the revisers of Sailing Directions £1 800 was allowed.

The preparation of charts was broken down into: drawing and engraving, £15 000; printing and, for H.M. ships, mounting, £64 000; Ordnance Survey services, £17 000. Instrument repairs, chart-boxes, conveyance of same were £6 300; chronometers £7 500; and the Nautical Almanac Office £4 523.

The extra pay for surveyors, the rates of which were unchanged, was £4 700; and lodging allowances, the hire of vessels, and the purchase of stores £9 200.

At the end of the war, the Hydrographer obtained the Board's approval to institute a scheme, begun in February 1919, by which masters and owners of merchant vessels released from control by the Ministry of Shipping could continue, as was necessary in wartime, to receive charts in folios with an automatic supply direct from the department of new charts, new editions, Notices to Mariners, and so on. Charts would be sold at published prices with a small charge for folio covers; replenishment would be at one shilling a copy; and charts could be corrected in depots at 3*d* per copy. Some sixty-five shipping firms accepted the scheme and a thousand ships were soon being supplied. Moreover, the scheme made possible the re-use and sale of charts that were on loan to ships at the time of the Armistice.

It meant that all the wartime depots remained in being, i.e. London, Sheerness, Portsmouth, Plymouth, Cardiff, Pembroke Dock, Rosyth (1915), Haulbowline, and Newcastle (1918); and abroad, Gibraltar, Malta, Port Said, Aden, Bombay, Colombo, Hong Kong, Simonstown, and Bermuda. At home it was necessary to add Liverpool, and abroad, after discussion with the Naval Staff, Kingston (Jamaica) and Trinidad.

It was not long before protests were being received, and there were questions in Parliament. The Hydrographer while regretting some loss of trade to the subagents said that the Admiralty had no obligation to them and they would still sell loose charts as well as having the benefit of the advertisement. There would be no cost to the taxpayer; if anything, the reverse would be the result.

Discussion continued, and in August 1919 the Hydrographer admitted the difficulty of a complete financial assessment, since it was not clear whether the depots, each costing some £2 600 per annum, other than those in the dockyards, would be on Government property. The Deputy Chief of the Naval Staff was not in favour of the scheme. He quoted a criticism in the *Nautical Magazine* and thought that as the profit to the Admiralty was problematical, chart supplies would be better in commercial hands. Moreover, there might be some unwelcome Admiralty responsibility. He thought the scheme should be abandoned and only reopened in the event of pressure from the mercantile marine. War experience should not be lost, and a scheme should be kept up to date in the department against any future emergency.

This view was in fact to prevail after Parry had been succeeded by Learmonth and the scheme was dropped in February 1921, two years after it had been instituted.

Concurrently, the conditions of chart-depot staffs was taken up in August 1919. The Hydrographer showed that they were in an anomalous position, sometimes under an admiral superintendent and sometimes under a commander-in-chief. He recommended dockyard grades for the assistants and that the attendants should be storehousemen. Again it fell to Learmonth to carry on the discussion.

The Hydrographer continued to handle the Astronomer Royal's administrative matters, and personnel were lent from the Royal Observatory during the war to assist the department in the preparation of certain special charts and diagrams.

In June 1918 the Hydrographer wrote a minute to the Board arguing for uniformity in timekeeping. Civil time was reckoned in two twelve-hour periods, although the Fleet had adopted 0 to 24 hours from midnight. The latter was to be used in the Admiralty Tide Tables for 1920, and it was used in the new French abridged *Nautical Almanac*, which might adversely affect the sales of the British *Nautical Almanac*. An astronomical day from noon to noon meant an unnecessary complication, and past acceptance of it did not constitute a reason for preserving any anomaly.

Parry took the chair at a conference convened by the Admiralty, which met four times in June/July 1918 and was attended by the Astronomer Royal and representatives of the Board of Trade, the General Post Office, the Home Office, the Meteorological Office, the Ordnance Survey, the War Office, the Royal Society, the Royal Astronomical Society, the Royal Geographical Society, and the Eastern Telegraph Company. M. Renaud, the French Hydrographer, was present and received official thanks for his special help. Barber's work as secretary was also acknowledged.

The conference found that the exclusive adoption of Greenwich time at sea was not practicable; that a world system of time zones in terms of hours plus or minus to G.T. was desirable, expressing the hope that other countries would comply; that there was no advantage in adopting summer time at sea; and that the astronomical day should commence at midnight. In February 1919 the Superintendent of the Nautical Almanac Office was directed to make the change in the astronomical day from 1925, and letters of information were widely circulated in scientific and Government circles.

The Nautical Almanac Office had moved in 1917 to 86 Lee Road, Blackheath, from Grays Inn, where the lease had run out. Cowell, the superintendent, had been satisfied that the move to the vicinity of the Royal Observatory had its advantages, but the staff unsuccessfully asked for a deferment on the grounds of the hardship a removal to such a distance away would cause them.

Towards the end of his period Parry played an important part in the development of international hydrography fostered by his grandfather. In June 1919 there was the International Hydrographic Conference, which at the suggestion of M. Renaud was held in London. Attended by twenty-four countries, the new Russian Government not, however, being among them, the conference was opened by the First Sea Lord, Admiral Wemyss, and Parry was elected chairman. Spicer-Simson acted as interpreter and Barber as secretary. The proceedings were published by H.M.S.O. in 1920 and the principal result followed in 1921 when the International Hydrographic Bureau was set up at Monaco, where Prince Albert I made a generous offer of accommodation, reflecting the relationship between hydrography and oceanography, to which Prince Albert had devoted so much of his life. Parry was then elected the first presiding director.

The history of the inception of the I.H.B. was later described in articles in the *I.H. Review*, notably Vol. I, 1923, by Parry and Vol. XXVIII, 1951, by Bencker, who succeeded Spicer-Simson as Secretary-General. Briefly, they record that Knorr, of the American hydrographic expedition to the Pacific, was the first to suggest, in 1878, an international board; that the First International Maritime Conference in Washington in 1889 had the uniformity of Notices to Mariners on its Agenda; and that the Eleventh International Congress on Navigation at St Petersburg in 1908, on a resolution proposed by General de Scholalski of the Russian Imperial Navy, remitted discussion of hydrographic matters to another meeting of seamen and engineers, also held in St Petersburg, in 1912. At this meeting, in which Britain took no part, M. Renaud saw the need for a conference of hydrographers. The war interrupted developments, but, during it, suggestions from various sources were received by Parry, so that in 1917 he listed the summoning of an international conference in London on the question of standardizing hydrographic publications and methods as one of the post-war problems.

The Hydrographer's annual report for 1921 succinctly described the object of the I.H.B. as the promotion of a more rapid and informed exchange of the hydrographic information obtained by the corresponding hydrographic departments of the various nations that subscribe to the upkeep of the bureau, and of researches on subjects affecting hydrography, together with coordination in methods as far as this may be possible.

Also in the international field the International Research Council was formed in 1919, and the Hydrographer was associated with the Royal Society's National Committee on Geodesy and Geophysics, concurrently set up, as he was with the Interdepartmental Committee on Research and Development in the Falkland Islands Dependencies.

In the oceanographic field, Dr G. H. Fowler, on leaving the department at the end of the war, wrote a paper proposing that the Admiralty should encourage the scientific study of the sea. In November 1918, after consulting the Commodore, Submarines, the Hydrographer submitted the proposal to the Board with his supporting comments. He entirely agreed with the contention that the Navy needed to study oceanography in times of peace, mentioning temperature, salinity, and density observations, and subsurface currents and tidal streams as well as vertical movements of the tides. He differed from Dr Fowler's view that other than surveying officers should be engaged in the work, but welcomed the Commodore (S)'s suggestion that experimental observations should first be made by a submarine in home waters. He agreed that a small oceanographic branch would be needed in the department. The Secretary of the Admiralty, however, saw the advisability of awaiting the outcome of the Peace Conference discussions on the future of submarine warfare, and the matter was taken up again in October 1919 after Learmonth had succeeded Parry.

It is worth recording that, after consultations between the Hydrographer, the Director of Scientific Research and other Admiralty departments, and with the Ministry of Agriculture and Fisheries, a submarine was allocated to make observations, initially in the Bristol Channel, during the summer of 1921. Professor Gardiner and Dr Fowler took part in the discussions; see pp. 139 and 144. And in 1920 Dr D. J. Matthews, a marine biologist, was lent to the department by the Director of Scientific Research and was to produce his classic *Tables for the Velocity of Sound in Pure Water and Sea Water*, published by the Hydrographic Department in 1927.

The future organization of the meteorological services of the country was discussed at length in an interdepartmental committee, and in July 1919 a Cabinet decision ruled that the Meteorological Office should be attached to the Air Ministry. All other departments were to be adequately represented, and, as Parry noted, the next step would be for the Air Ministry to call them together. His successor represented the Admiralty on the Meteorological Committee as Hydrographers had done heretofore. The branch in the department continued until 1920, its R.N.V.R. officers decreasing in numbers and becoming styled technical officers at the end of the war.

Progress of marine surveys

During the war years surveying was restricted to essential work, mainly for the Fleet or for naval operations; only in 1919 was there a resumption of normal activity overseas.

At home in August 1914 the *Triton* and *Research* were paid off, never to recommission after thirty-two and twenty-five years' service respectively. They were the last of the paddle-wheelers. The *Daisy* and *Esther* were diverted to minesweeping duties. Their officers were distributed throughout the Fleet, many of them undertaking a surveying role. The *Endeavour*, Comber, surveyed in the Humber and the Tyne until sent to the Mediterranean in September 1915.

The *Hearty* continued surveying throughout the war and after, under the successive commands of Edgell, Comber, Reyne (1916–18), Chearnley, and F. J. B. Gibson. Her work was mainly on the east coast in Inverness Firth and Moray Firth and The Wash, with some time in the Thames estuary and the Medway. The *Daisy*, Comber, Jackson, and Harvey, and the *Esther*, Gibbings, Maxwell, Scott, and Knowles, returned to surveying duties in 1916. They were employed in the Thames estuary, The Downs, and the Dover Strait; and in 1918 were entirely engaged in war operations in Dover Naval Command. In 1919 the *Daisy* visited Lerwick to fix experimental hydrophone positions and the *Esther* laid buoys in company with a Trinity House vessel to delineate the Northern Barrage while she was working in Inverness Firth. The *Hearty* buoyed a minefield off the Yorkshire coast. Throughout the period Combe carried on a survey of the Firth of Forth including Rosyth and Granton, and from 1917 Mr Lanyon conducted the south-coast-of-England surveys of Portsmouth and Plymouth.

An additional vessel, the *Melisande*, was commissioned by Maxwell in 1918 for surveys on the south and east coasts of England, but she suffered continual engine-trouble and was returned to her owners in the following year. In 1916 Somerville, while in command of H.M.S. *King Alfred* in the North Atlantic, was able to make a most useful survey of the Salvage Islands.

From 1915, a number of surveying officers was appointed to the Admiralty War Staff. Hancock, home from the *Sealark*, was the first, and he was also the first to be decorated with the D.S.O. for carrying out surveying operations of considerable importance under heavy gun-fire. His award followed a recommendation in Admiral Bacon's dispatch from Dover of 29 May 1916. Among other officers similarly employed from 1916 were Douglas, succeeded by Edgell in February 1917, and Haselfoot. Douglas in 1916, and later Haselfoot, adapted surveying methods and invented various devices to assist the monitors and other vessels in their bombardment of the Belgian coast. Douglas had previously made similar contributions at the Dardanelles and Haselfoot on the Palestine coast.

The part that surveyors played in the narrow waters of Dover Strait was graphically noted by Admiral Andrew Cunningham in *A Sailor's Odyssey*, 1951. Having described how in H.M.S. *Termagant* he escorted monitors to their supposed bombarding anchorages off the Belgian coast in a thick fog, and wondered how they could fix their precise location for indirect fire, he wrote: 'I discovered that they had Captain H. P. Douglas of the Hydrographic Department on board and that he was responsible for this fine piece of navigation.' Douglas, Haselfoot, Fraser, Stevens, and Tinson were in the Zeebrugge blocking operation.

Other surveying appointments in home waters were those of Tinson and Stevens who served in the Grand Fleet and were both promoted to commander in 1916. There was also Schafer who lost his life in March 1918 when surveying for the Northern Barrage in the *Gaillardia*, which had been temporarily appropriated for surveying in October 1917. Another serious loss to the surveying service was the death of J. M. Jackson on board the *Daisy* at Dover, also in March 1918.

Abroad, in 1914, the *Merlin* paid off at Hong Kong and F. J. B. Gibson took charge of Hong Kong chart depot. The *Fantôme* and the *Sealark* paid off at Sydney, and some of the latter's officers and men joined the expeditionary force for Samoa, while the former did service with the Australian Navy. The *Mutine* paid off at Bermuda, and three of her young surveying officers joined H.M.S. *Good Hope*, losing their lives at Coronel.

In 1915 the *Endeavour*, Edgell, left England complete with printing equipment[1] to join the Eastern Mediterranean Fleet where Douglas was the senior surveying officer on the admiral's staff. Enemy batteries at the Dardanelles were fixed by triangulation, Woodhouse and Knowles observing at Cape Helles under gun-fire, immediately prior to the Gallipoli evacuation in 1916, at the end of which year Douglas, Edgell, and the officers and men of the *Endeavour* received the marked approval of Their Lordships for their work.

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[1] See p. 299.

Various surveys were then carried out in the Aegean islands and at Salonika, and later at other places in the eastern Mediterranean. Hancock succeeded Edgell in February 1917 at Gibraltar but he lost his life in August 1918 when H.M.S. *Comet*, in which he was taking passage from Malta to the scene of a war operation, was sunk in a collision. Reyne succeeded Hancock at Malta and in 1919 began an extensive survey of the north coast of Egypt, for which the Survey of Egypt, Cairo, provided triangulation data and assistance.

In 1916 Maxwell, when navigating officer of H.M.S. *Challenger*, surveyed for the military operations in the Cameroons and also at Duala. He received the thanks of Their Lordships and was made a Chevalier of the Legion of Honour. Haselfoot, as navigating officer of H.M.S. *Humber*, made a survey of Marsa Matruh where he had to contend with hostile Senussi, and in 1917 he was on the staff of the Commander-in-Chief, East Indies. He had the hired vessel *Enterprise*, Daugleish, under his orders, in which he surveyed in the Red Sea on the channels inside the Farisan Bank. Nares succeeded Daugleish in September 1917 and the ship reconnoitred and acted as flagship for a week in November for the operations against Gaza. Woodhouse was once more assisting military operations on shore.

At the end of 1917 the *Enterprise* returned to surveys in the Strait of Tiran and the Gulf of Aqaba and then continued on the Farisan Bank until July, 1918. After the Armistice, Nares left the ship in command of Woodhouse at Alexandria and went to Hong Kong with officers to recommission the *Merlin*. On the latter's arrival at Port Said in January 1919, her complement was completed from the *Enterprise*, which was then returned to the Sudan Government. Meanwhile, Woodhouse had surveyed Lake Timsah. Under Nares, the *Merlin*'s first survey was of Loheiya until work had to be suspended in June owing to the excessive heat. She then went to Hurghada in the Strait of Jubal, where extensive oilfields had been reported; and she was at Gibraltar in August for a much needed refit and retubing of boilers. Royal Indian Marine surveying officers also took part in war operations and assisted in the Mesopotamian campaign.

In June 1919 the *Fantôme* and the *Mutine* were recommissioned for surveying by Scott at Sydney and Glennie at Bermuda respectively. The *Fantôme* needed a major refit before the end of the year, but parties surveyed Port Jackson and Sydney Harbour, and triangulated Port Stephens. Glennie, while the *Mutine* was refitting, had the use of a drifter for surveying Hamilton Harbour dredged channel and the Tower Cut at St George's Harbour; he then began a survey of the Ship Channel to Whalebone Bay.

Before leaving this account of war operations, the honours and awards received by surveying officers and civilians of the department may be recorded:

Afloat

C.M.G., Douglas, Combe, and on general service, Glennie and Somerville.
D.S.O., Hancock, Fraser, Stevens, Haselfoot, Knowles, F. J. B. Gibson.

Ashore

K.C.B., Parry; C.B.E., Learmonth, Smith, Dr Fowler; O.B.E., C. M. Gibson, Barber, Underhill, Codd, Llewellyn, who first received the M.B.E.

The Roll of Honour contained the names of Hancock, Acting Commander (Retired) J. S. Schafer, and E. C. Pratt, a cartographer who had been permitted to join up for military service as did a number of those in the secretariat and Issues Branch.

Soon after the end of the war, Parry, on the 28 November 1918, submitted on the First Sea Lord's instructions, a memorandum on surveys of the coasts and waters of the Colonies of the Empire.[1] He recalled that the matter was under consideration prior to the outbreak of war and attached Purey-Cust's statement of 1914 on hydrographical knowledge.[2]

Parry described pre-war arrangements and explained that the Admiralty's policy had been to undertake work if a ship could be spared and if the colony paid half the annual cost of maintaining the vessel and meeting the pay of officers and men. This, he said, was not satisfactory to either party, as the Admiralty had to place emphasis on naval requirements. Moreover, much of the work was in Imperial interests and had to be done whether the colony contributed or not. He instanced Canada as an exception in starting her own surveys because the services of retired Admiralty surveyors were available, but this example could not now be followed elsewhere owing to the lack of such officers.

Parry continued with the contention that in the interests of trade a new departure must be made by the Imperial Government, detailing sufficient ships for Imperial and colonial needs. The large number of ships that would shortly be set free, and the probable redundancy of officers in the Navy, made the time most favourable. An Imperial surveying service headed by the Hydrographer, whose department would publish the resulting charts, would be much more efficient and economical than a series of small surveying services run by the several Colonies, even if trained staff could be found and all the Colonies could afford the expense. 'The whole annual cost to the Imperial Government would not be great, and the satisfaction which would be felt by the Colonies would be one more link in the chain which bind them to Great

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[1] File H.D. 4303/18.

[2] See p. 272.

Britain.' No claim had been nor could be made for repayment of surveys of the Crown Colonies.

The amount of work needed was enormous and the large amount necessary in home waters and on the sea routes precluded all possibility of diverting ships from the work in hand prior to the war. Nine ships would be needed over a large number of years for work in both Imperial and colonial interests in Australia, New Zealand, the Pacific islands, the south, east, and west coasts of Africa, the West Indies, Straits Settlements, and Egypt. Their cost would be £160 000 per annum (£100 000 more than pre-war), a part of which would be recovered by the sale of charts, now more world-wide than ever before; and chart plates remain a source of revenue as long as the surveys on which they are based remain effective. 'This country has such vital interests over such a large portion of the Globe that it necessarily has to perform the greater part of the surveying of the World for the safety of its own ships, and the sooner the World is adequately charted the better it must be for the interests of this country.' Of the necessity for the work there could be no question, and of the Colonies' needs, the only questions were the incidence of cost and the rate of accomplishment. Of the former, Parry said it should fall entirely on the Imperial Government, and of the latter, that the time for a special effort had now arrived.

The memorandum was adopted by the Admiralty Reconstruction Committee in January 1919, and a letter was sent by the Colonial Office to the self-governing Dominions in March asking for their views. At Parry's suggestion, copies of documents were given to Admiral Jellicoe who was about to make his Dominion tour. In reply to the Colonial Office, the South African Union Government suggested a monetary contribution or assistance as heretofore by their land surveyors; the New Zealand Government considered it desirable that work should be carried out by the Admiralty with half the cost defrayed by them; the Australian Commonwealth Government said they would be glad if the Admiralty would carry on, halving the cost with them, pending their establishment of a surveying branch.

There the matter rested until an Admiralty memorandum of 31 March 1921 on Empire naval policy and cooperation was submitted to the Cabinet for the forthcoming Imperial Conference. The policy had changed:

> It is evident that the reduction in the Imperial Navy and the need of economy render it hopeless to increase the present Admiralty surveying service, either in ships or personnel, whilst the immediate need of work in Home Waters renders it impossible to divert vessels to undertake further surveys of the Coasts of the British Dominions. There appears therefore no alternative but for the Overseas Governments to endeavour to establish their own hydrographic surveys. . . . All that the Admiralty can do is to repeat their offer of 1907 to render assistance to the Governments to do so, by affording facilities for training officers, selected by the Overseas Governments, in Admiralty surveying ships.

Canada and India were quoted as having successfully founded their own surveys. It was noted that the *Fantôme* was working in the important Torres Strait. The concluding paragraph read:

> If such a policy is adopted as here outlined, the Dominion Governments would be then responsible for such surveys as they may require within their own waters. The British Government would undertake the surveys of the United Kingdom and of the Colonies and Protectorates, together with surveys required in general for Imperial and strategic reasons, and the development of trade, including Ocean routes, etc., the requirements and limits of which cannot of necessity be clearly defined, but involve an overwhelming amount of work to be done.

It is in context here to note the ready assistance of Mr W. J. Stewart, Hydrographer of the Department of Naval Service, Ottawa, in nominating four of his staff, Fraser, Prittie, Foreman, and Morrissey, in March 1918 to serve as lieutenants, R.N.V.R., in British surveying vessels. Parry had obtained the Board's approval for this approach after pointing out the dearth of surveying officers and how he had privately learnt that Mr Clifford Smith (later to be the Canadian Hydrographer) was serving in a Canadian regiment in England and had already arranged for his appointment to the *Hearty* as a lieutenant, R.N.V.R. Messrs Mackinnon and Willis also did equivalent service.

When Parry handed over to Learmonth on 1 September 1919 there were forty-two surveying officers afloat in six ships and two parties, while the naval officers in the department numbered eighteen. He had obtained six minesweepers for conversion by June 1919 to home surveying ships—they were renamed *Beaufort*, *Collinson*, *Crozier*, *Fitzroy*, *Flinders*, and *Kellett*. Four were commissioned in the following year to replace the *Hearty*, *Daisy*, and *Melisande*. The *Collinson* and the *Crozier*, never manned, were offered to colonial Governments, the latter being taken up by the South African Government as the *Protea* in 1921. In 1920 there were, therefore, four ships in home waters and four, the *Endeavour*, *Fantôme*, *Merlin*, and *Mutine*, abroad. All ships were painted white and wireless-telegraphy sets were fitted in foreign ships.

In the number of officers quoted there were three captains and seven commanders at sea, or in the department between sea appointments. Promotions to commander and captain had continued to be the subject of half-yearly recommendations by the Hydrographer. Surveying pay to surveying officers and surveying recorders (three per ship) continued without change.

In January, Parry represented to the Jerram committee on naval pay and allowances that all men in surveying ships should receive a special allowance. He quoted the regulations whereby crews of general-service vessels employed on surveying received extra pay, and he considered that this acknowledgment of the strenuous nature of the work should apply to surveying vessels. This would remove the longstanding discontent and dissatisfaction now unfortunately felt. Moreover, surveying ships were small and their larger crews strained the accommodation. As a result of Parry's representations the Order in Council of May 1920 approved hard-lying money for crews of surveying vessels on the scale for torpedo-boat destroyers, and limited in the case of home ships to periods when they were in full commission. The allowances for officers was the subject of further discussion in Learmonth's time.

In 1915 there appeared a new edition of *General Instructions for Hydrographic Surveyors*, which adopted a different layout and introduced much new material, and although amendments and additions were issued from time to time, it was to remain in force until 1933. Commonly known as the ' Green Book ', its preface said that the subjects demanding the attention of the hydrographic surveyor were many and various, first and foremost being a complete survey of the seaboard allotted. Tides, currents, winds, and weather were mentioned, followed by oceanographical observations. Geological knowledge was of practical value in studying the connexion between the geological formation above sea level and the contour of the sea bed in order that the best arrangement for sounding might be adopted. Method was above all things necessary, and also uniformity in the records, to which end, books and forms had been established.

There were eight sections: I. Instruments included equipment, with plates of the uniform system of marking leadlines and the 1912 floating beacon. II. Books and stationery. III. The survey wherein the soundings were undoubtedly the most important part—a heavy responsibility rested upon surveyors in view of the size, weight, and value of modern ships. Pinnacle rocks must be swept for and all field work must be plotted on the spot, or, at worst, while all the facts connected with it were fresh in mind. IV. Draughtsmanship, with plates of the names and styles of lettering, of a fair chart to show colourings and modes of writing, and of views. V. Sailing Directions, with detailed tabulated instructions for their composition including the system of orthography, which had been originally introduced by Washington and was accepted by the Royal Geographical Society and public departments in Great Britain and the U.S.A. VI. Lists of geographical positions. VII. Datums used on charts showing that many countries had adopted M.L.W.S. and the United States the mean of all low waters. VIII. List of the Hydrographic Department's publications, mentioned on p. 270.

There was a fourth edition of *Hydrographical Surveying*, Wharton and Field, which was revised by Field in 1919. His preface acknowledged in particular Learmonth's description of his surveying methods on the North Sea banks and Close's[1] *Text Book of Topographical and Geographical Surveying* for the use of rectangular coordinates in triangulation and plotting. The ship sounding-gear described was the Somerville and the current-meter was the Pillsbury, both previously mentioned. Various sweeping methods were illustrated. This edition remained in force as the standard textbook until 1938, when the *Admiralty Manual of Hydrographic Surveying* was published under the editorship of Captain R. M. Southern. Plans for the writing of an official manual by Haselfoot in 1919 did not bear fruit.

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[1] Colonel Sir C. F. Close, K.B.E., C.B., C.M.G., R.E., Director of the Ordnance Survey.

Some details of new instruments have been given on p. 306. The Hydrographer saw a report in March 1917 on the use of taut-wire measuring-gear[1] to fix the position of the minelayer H.M.S. *Princess Margaret* some eighty miles off Flamborough Head. On inquiry, he was told that the gear had been used for many years by telegraph ships, had been fitted by the Telegraph Construction & Maintenance Company, and consisted of piano-wire running out over a measuring-wheel. It was to become a valuable piece of surveying equipment after the war.

Other wartime developments were adapted for surveying purposes. There were the oropesa sweep, subaqueous sound-ranging, and depth measurement by depth-charge explosions, the echo returning to a hydrophone. Douglas fostered the development of the last, which was to be followed up in 1921 with the fitting of the first experimental echo-sounding machine. In 1919 there was the invention of the Kitchen reversible rudder, which was later to be used in surveying motor-boats. Surveying from aerial photographs was also under development.

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[1] According to information from the Telegraph Construction & Maintenance Company, taut-wire measuring-gear was originally designed by a Mr C. A. O. Berner of that company in 1903 when the Pacific cables were being laid.

Biographies: Afloat and ashore

CAPTAIN J. W. COMBE, C.M.G., R.N.

1893–1920

James William Combe began surveying as a sub-lieutenant in 1877 when he joined the *Alacrity*, Moore, spending six years in the Fiji Islands, and being promoted to lieutenant in 1880. In 1881, G. E. Richards succeeded Moore, and in the following year the *Alacrity* was replaced by the *Renard*. The survey was closed in 1883 and Combe returned home.

Towards the end of 1884 Combe joined the *Paluma*, on the Australia Station and served again under Richards for four years and a half, mainly on surveys of the inner route off Queensland. Leaving the *Paluma* in 1889, he was next in the *Penguin*, Moore, on surveys in Australian waters and on the China Station. In 1893 he returned to England and commissioned the *Waterwitch*, sailing her out to the Australia Station for further surveys of the Fiji Islands where he had gained his first surveying experience. He was promoted to commander in 1896.

In 1897 he was back in England, and after six months in the department he took command of the *Triton* for surveys on the east coast of England. After only one season, he was abroad again, commanding the *Penguin* for three years, at first in Australia and then in New Zealand. In 1903 in England he was placed on the Retired List with the rank of captain and served for a year in the department.

During 1905 and 1906 Combe undertook detached surveying work at Sligo, Ireland, and at Platea, Greece, the latter for the Mediterranean Fleet. In 1907 he was in charge of the west-coast-of-England survey using the hired vessel *Argo*, and in the following year he succeeded Tooker in the *Ellinor* on the Newfoundland survey until it was closed down in 1913.

On his return to England, Combe was employed visiting the larger ports on U.K. coasts in order to bring Admiralty charts up to date for the latest harbour improvements. He continued this work when the 1914–18 war broke out, and from 1915 until the end of 1919 he was continually engaged in surveys of the Firth of Forth. For his war services he was awarded the C.M.G., and he reverted to the Retired List in 1920.

VICE-ADMIRAL E. C. HARDY

1902–1914

Ernest Cecil Hardy joined his first surveying ship, the *Egeria*, Field, in 1891 as a lieutenant and spent three years in Borneo waters and the eastern approaches to Malacca Strait. There followed three years in the *Rambler*, G. E. Richards, on the West African coast, in the West Indies, and in North America.

On his return to England in 1898, Hardy was for two years in the *Research*, Moore, for surveys in home waters. In 1900 he joined the *Egeria*, Simpson, for the second time, though now in British Columbia.

In 1902 he took command of the *Waterwitch* on the China Station where he spent over three years, being promoted to commander in 1903. In 1905–6 he was Surveying Officer for Special Business in the department and then fitted out a new surveying vessel, the *Fantôme*. He commissioned her early in 1907 and sailed her out to the Australia Station, but his health was shortly to break down, and he was invalided home in 1908.

After a year in the department, Hardy was in 1909 at sea again, commanding the *Mutine* for two years and a half, spent mainly on the Liberian and Zululand coasts of Africa. In 1912 he commissioned the specially designed new ship *Endeavour* and surveyed in the Shetland Islands until 1914, although he and his ship's company changed ships with the *Hearty* in 1913. For the war years, he was Assistant Hydrographer to Parry and continued in the department for special service for a short time after he relinquished the post in 1919.

Hardy was placed on the Retired List with the rank of rear-admiral in 1921, and advanced to vice-admiral in 1926.

VICE-ADMIRAL H. B. T. SOMERVILLE, C.M.G.

1904–1914

Henry Boyle Townshend Somerville first joined the surveying service in 1889 as a lieutenant and spent three years in the *Dart*, Frederick, on the Australia Station, but mostly in the New Hebrides. There followed a similar period in the *Penguin*, Balfour, on the same station, but mainly in the Solomon Islands.

In 1897 Somerville joined the *Egeria*, Smyth, and was for three years in British Columbia. On his return to England in 1900, he was appointed to the *Triton*, G. E. Richards, for two seasons in home waters, being promoted to commander at the end of 1901. During 1902 he was employed on a tidal survey of the Channel Islands, and in 1903 he became a naval assistant in the department, being detached for four months' special service in the Persian Gulf, where he effected certain surveys for strategic purposes—work that earned him an expression of Their Lordships' appreciation.

Early in 1904 Somerville fitted out the *Sealark*, which he commissioned in September; and in her he carried out, during three years, surveys in the Red Sea and off Ceylon and made an extensive scientific cruise in the Indian Ocean, with Messrs Gardiner and Cooper embarked. Back in England at the end of 1907 he next spent some months in the department before taking charge for four years from April 1908 of the west-coast-of-England surveys using the hired vessel *Argo*. He was promoted to captain in June 1908.

From 1912 until the outbreak of war in 1914, Somerville commanded the *Research* in home waters. During this period he developed the ship sounding-gear, which was to be used until echo-sounding took its place. He spent the first three years of the war in general service, commanding H.M. Ships *Victorian*, *Amphitrite*, *King Alfred*, and *Devonshire*. While in the *King Alfred* he was able to carry out a useful survey of the Salvage Islands in the North Atlantic. From October 1917 to 1919 he was on special service with the Naval Staff of the Admiralty, and in August 1919 he was placed on the Retired List with the rank of rear-admiral and the award of the C.M.G. for his war services.

In 1922 Somerville undertook the preparation of a new edition of the department's publication *Ocean Passages for the World*, and in 1923 he was chairman of an Admiralty committee on tides, which was convened to consider the adoption of the harmonic method of prediction by the department.

In 1925 he was advanced to vice-admiral on the Retired List, and in 1936, at the age of seventy-two, he was the victim of a dastardly murder by I.R.A. gunmen at his home in Castletownshend. His advice and help to young men of the locality wishing to join the Royal Navy was apparently the reason for his murder.

Somerville was the author of a number of technical papers and books on naval subjects, some of which were based on his personal experiences and appeared in *Blackwood's Magazine*. He was vice-president of the Cork Historical and Archaeologist Society and a Fellow of the Royal Anthropological Society.

COMMANDER R. L. HANCOCK, D.S.O., R.N.

1910–1918

Reginald Lionel Hancock joined the *Penguin*, Combe followed by Pudsey Dawson, as a sub-lieutenant in 1901 and spent three years on surveys in New Zealand waters, becoming a lieutenant in 1902. In 1904 he commissioned the new ship *Sealark*, Somerville, for three years' work in the Red Sea, off Ceylon, and on a scientific cruise in the Indian Ocean.

After a year in home waters in the *Triton*, Pudsey Dawson, Hancock went to the *Fantôme*, Pasco, in 1909 for surveys on the north-west coast of Australia. Early in 1910, when still a lieutenant, he obtained his first command, the *Waterwitch*, and surveyed in Singapore Strait; and on return home in 1912 he was in charge of surveys in the Shetland Islands.

In 1913 Hancock succeeded Glennie in the *Sealark* and was either in the Solomon Islands or on the coast of Queensland until the outbreak of the 1914–18 war, upon which he paid off the ship at Sydney and returned home. In April 1915 he was appointed for special service under the Chief of the Admiralty War Staff and was promoted to commander in June. During this appointment he was awarded the D.S.O. as the result of a dispatch by Admiral Bacon from Dover in May 1916—Hancock's surveying operations were reported as being of considerable importance and carried out under heavy gun-fire.

Early in 1917 he took command of the *Endeavour* under the orders of the Commander-in-Chief, Mediterranean.

While serving in the *Endeavour* Hancock lost his life in 1918 as the result of a collision when he was taking passage in H.M.S. *Comet* to the scene of war operations in the Adriatic. His untimely death was a great loss to the surveying service and ended a career of exceptional promise.

COMMANDER T. G. COMBER, R.N.

1914–1917

Thomas Geoffrey Comber joined the *Triton*, Purey-Cust, as a sub-lieutenant in 1903 but was soon transferred to the *Rambler*, Smyth followed by Monro, and spent three years on the China Station, being promoted lieutenant in 1904.

In 1906 he had another short spell at home in the *Triton*, Pudsey Dawson, before joining the *Mutine*, Munro, for three years' surveying mainly on the Liberian coast. There followed in 1909 another short appointment to the *Triton*, and in 1910 Comber joined the *Fantôme*, Nares, later Reyne, on the Australia Station where the main survey was of the Buccaneer Archipelago on the north-west coast of Australia.

In 1913, back in England, he was initially in the *Research*, Somerville, and then in the *Endeavour*, Learmonth, working on the North Sea banks. He succeeded Learmonth in command shortly after the outbreak of war, and then in September 1915 changed ships with Edgell in the *Hearty*. For a time in 1916 Comber was surveying officer on the staff of the Flag-Officer, Fourth Battle Squadron, in H.M.S. *Benbow* but later in the year took command of the *Daisy* when she returned to surveying for war operations. He continued this work until the middle of 1917 and then reverted to general service. He was made a commander on retirement.

COMMANDER J. M. JACKSON, R.N.

1917–1918

John Metcalfe Jackson joined surveying as a sub-lieutenant in 1904 and spent a year in the *Research*, Smyth, in home waters. In 1905 he went to the *Penguin* and served on the Australia Station almost continuously for nine years, being promoted lieutenant in 1905.

Two years in the *Penguin*, Simpson, were mainly on the inner route off the Queensland coast as was the following year when the *Fantôme*, Hardy, succeeded the *Penguin*. In 1908 when Pasco relieved Hardy, the survey was transferred to the north-west coast of Australia.

Jackson left the *Fantôme* in 1911 and soon after joined the *Sealark*, Glennie, later Hancock, working in the Solomon Islands or on the Queensland coast until the outbreak of the 1914–18 war. On passage to Sydney via Suva to pay off, the *Sealark* met the expedition bound for the occupation of Samoa, and Jackson was appointed Fleet Minesweeping Officer, in H.M.A.S. *Australia*.

After the occupation of Samoa, Jackson commanded a small expedition that surprised and captured the German surveying ship *Komet*. He commissioned her as H.M.S. *Una* and for two years patrolled in the western Pacific islands, during which service he commanded a combined British and French punitive expedition against the bushmen on the island of Malekula in the New Hebrides.

In 1917, on his return home, Jackson took command of the *Daisy*, which was employed in the operations on the Belgian coast. He died on board her at Dover in 1918.

There follow biographical notes on two officers who were never in charge of surveys but who nevertheless rendered distinguished service.

COMMANDER H. D. WARBURG, M.SC. R.N.,

Harold Dreyer Warburg was born in 1878 and entered the Navy to become a midshipman in 1894, a sub-lieutenant in 1898 when he studied navigation at the R.N. College and a lieutenant in 1900. He began surveying in the *Research*, Moore, in Scottish waters during the latter part of 1899 and was then in the *Waterwitch*, Lyne, Hardy, and Glennie, on the China coast until 1906. After a short appointment in the department, he was again in the *Research*, Smyth and Simpson, mainly in Scottish waters until 1910, being promoted to lieutenant-commander in 1908.

In 1902 Warburg was troubled with defective vision but was found fit for service wearing glasses, in 1906, however, his eyesight limited him to service in surveying ships. He began his long service in the department in 1911 as a naval assistant, and in 1912–13 he was Surveying Officer for Special Business. In the latter appointment, he took up a special study of tides and new methods of prediction, much of it in his spare time, so that in October 1913, on Purey-Cust's representation, he was made the officer ' in charge of Tidal Work '. Purey-Cust asked for an allowance for him of £100 per annum, but the Treasury ordained periodic payments of £100 on completion of the predictions for each four of twenty ports, although there was an immediate payment of £100 for past work.

In 1917 Warburg was appointed Superintendent of Tidal Work (a branch in 1933) having held the rank of acting commander from 1915. He retired as a commander at the end of 1919 and was reappointed on full pay, plus a fifteen-per-cent bonus, until 1923 when a new scale for retired officers in the department was introduced. He then received the basic £850, plus two £100 increments and a superintendent's allowance of £100, the small decrease in his emoluments being offset by an increment of £60 in 1927.

Warburg retired from service in the department in October 1938 but was re-employed in August 1939 for the war years until November 1945 when he finally reverted to the Retired List. He was then employed as a reviser working at home on *Tidal Streams of the British Isles* for a period envisaged to end in May 1947, which turned out to be the date of his death, aged sixty-eight.

In contributing so much in the field of tidal prediction, Warburg worked closely with A. T. Doodson, F.R.S. They were jointly awarded the Thomas Gray Memorial prize in 1934 and were joint authors of the *Admiralty Manual of Tides*.

CAPTAIN V. R. BRANDON, C.B.E., R.N.

Vivien Ronald Brandon was born in 1882 and joined the Navy in 1899, became a sub-lieutenant in 1901 and a lieutenant a year later. He was awarded the Ryder Memorial prize in 1901 and missed by only two marks the Beaufort prize in 1902, in which year, however, he received a prize for French.

His first surveying ship was the *Egeria*, Parry, from 1903 to 1906 in British Columbia, and then, following three months in the department, he was in the *Merlin* when she sailed for the China Station late in 1906. When Parry, who was in command, was invalided from the Rea Sea, Brandon succeeded to the command for three months until the arrival of Walter, under whom he served until 1908.

In 1908–9 Brandon served for six months in the department and then sailed for special duty in H.M.S. *Cornwall* on a Baltic cruise. He received approbation for a useful report on German naval matters, and during 1910 wrote special Sailing Directions for the Belts, Kattegat, and the Baltic. In January of that year, then a lieutenant-commander, he could not be spared to go abroad to study German, but in August while on leave in Germany he was arrested, charged with espionage, and sentenced by the German justices to four years' confinement in the fortress of Glatz. On his release in May 1913 he was allowed full pay and time for the period, and he qualified as a German interpreter.

In 1914 after a few months in home surveying ships, Brandon returned to general service, undertaking special duty and joining the Naval Intelligence Department for the war years. In April 1919 he became Assistant Director and was on a committee of inquiry into breaches of the Articles of war. In January 1920 he was mentioned in dispatches for mine-clearance work in Norwegian waters and was then Senior Naval Officer, Persian Gulf, until 1923, receiving the appreciation of the Political Resident for various services.

Returning to the surveying service, Brandon was in the department until 1927 when he became the Professional Officer in the Mercantile Marine Department of the Board of Trade until 1942. He died in January 1944 aged sixty-one.

W. D. BARBER, O.B.E., I.S.O.

1884–1922

William David Barber was born in 1861 and entered the Civil Service in 1879. In 1884 he joined the Hydrographic Department, in which he was to spend his career, and was one of two clerks authorized by the 1883 committee of inquiry into the department. Thus the civilian branch was founded, which was to take over the secretarial and administrative duties and, later, chart issues.

His ability was such that in 1890 and again in 1896 Wharton recommended him for promotion, but within the department, since he would view his departure with dismay; and in 1891 he was advanced to the new upper class of second-division clerk.

In 1893 he took over from Underhill, then Chief Civil Assistant, the duties of secretary of the Board of Visitors to the Royal Observatory, with its allowance of £10 per annum.

The Hydrographer's repeated submissions were unsuccessful in obtaining the grade of staff clerk for the senior clerical post, and Barber's next advancement was to Chief Civil Assistant. He succeeded Parry in 1903 to be the first civilian holder of this appointment at a time when there were five second-division clerks and two assistant clerks.

His responsibilities for administration, chart printing, and supplies were well described in his evidence to the 1905 committee, one result of which was to maintain his salary at £550–600 but to make its increments £20 annually instead of £50 quinquennially. In 1911 his salary was increased by £50, and in 1912 he acted as secretary to the committee on the reorganization of Admiralty charts.

In 1913 a new agreement was negotiated with Malby, which included the appointment of an Admiralty supervisor, and Barber undertook it with an allowance of £200 per annum. During the war he served with distinction under Parry and was awarded the O.B.E. in 1917, having previously received the I.S.O. In 1918 he was secretary to the Admiralty conference on time-keeping at sea.

After the war he was much concerned with negotiating the post-war complement of the department and the setting-up of the Admiralty Chart Establishment, which came into being at Cricklewood in 1923. He acted as general secretary to the International Hydrographic Conference of 1919 in London, for which he received commendations, included among which were two from the Norwegian and Swedish Governments. In recognition of his services as secretary of the Shackleton Relief Committee he received a £50 gratuity.

He retired in 1922, and during his retirement he became a director of the *Civil Service Stores, in which capacity he served until 1950. He died in 1952* aged ninety-one.

A. GIBSON, B.SC.

1875–1917

Alexander Gibson, born in 1856, joined the department as a draughtsman in 1875, having previously served an apprenticeship as a mechanical engineer, studied at Owens College, obtained a B.Sc. at Victoria University, and been a Science and Arts double gold medallist in applied mechanics and geometrical drawing. Starting as a third-class draughtsman under Boyle when the chart-producing staff numbered five, Gibson, under the reorganization introduced by the 1883 committee, became one of six unclassified draughtsmen under a chief draughtsman, Powell. In 1905 when two chief draughtsmen were allowed, Gibson was promoted, though Briggs was his senior, and the conditions and work of the draughtsmen were well described in the evidence to the committee of inquiry of that year.

In 1909 when on Field's insistence the draughtsmen were restyled cartographers, Gibson was made chief cartographer, first grade, with a staff of two chiefs, second grade, twelve cartographers, and four hired draughtsmen. In 1912 he was much concerned with the inquiry into the reorganization of Admiralty charts and the decision preceding this reorganization by which there should be two draughtsmen for each cartographer reduced from the establishment. He supervised the rapid expansion of work, including the special charts required by the Fleet, and of the staff of Chart Branch on the outbreak of the 1914–18 war. Thus, there were, in 1917, nineteen cartographers, twelve draughtsmen and twenty draughtswomen.

Sligant remembers 'Pa' Gibson as a dour Scot with a kind heart, who was a good friend to his cartographic staff and who was held in great esteem by the Hydrographers under whom he served. He was a rapid and accurate worker, but it was in the recording, analysis, and utilization of the increasing mass of incoming data that he also showed himself as a man of ideas and energy—for example, he instituted the Register of Geographical Astronomical and Geodetic Positions (newly observed or deduced), the compilation books (noting data used on a chart including dangers on which there might be a conflict of evidence), and the Chart Branch order-book (promulgating decisions on new practices). He was adept in drawing up chart schemes, which were initiated in 1912. He died in May 1917 while re-employed as an additional chief cartographer following his retirement the previous year.

His elder son, A. Foxcroft Gibson, was a cartographer from 1900 to 1920 when he resigned, having in the war years been seconded to Operations Division. He was a capable draughtsman and compiled, among other things, charts from Japanese sources, Japanese having been included among the language subjects for cartographers' Civil Service examinations which his father had revised in 1910–11. In retirement, A. F. Gibson became a Baptist minister, and as a talented pianist and singer he made many appearances for charitable institutions, especially in Caledonian circles. He died at Banff in 1956.

THE PRINCIPAL SURVEYS OF 1915

HOME

Comber	*Endeavour*	ENGLAND, EAST COAST	The Humber and the Tyne
Edgell, Comber	*Hearty*	ENGLAND, EAST COAST	Thames estuary channels, the Medway
Combe	—	ENGLAND, SCOTLAND	Principal ports, Firth of Forth, the bridge to Bo'ness
Hancock			War surveys and experimental operations

FOREIGN

Edgell	*Endeavour*	MEDITERRANEAN	Operational surveys in eastern Mediterranean under the Commander-in-Chief
Douglas		MEDITERRANEAN	

BY THE MARINE SURVEY OF INDIA

R.I.M. officers		PERSIAN GULF	Surveys for Mesopotamian campaign

Douglas joined the Eastern Mediterranean Fleet in February to superintend surveys made by navigating officers and to fix enemy batteries by triangulation. On 5 September orders were given for the *Endeavour* to be fitted with two lithographic presses and other equipment; and under the command of Edgell, who had changed ships with Comber in the *Hearty*, she arrived at Mudros on 22 October. The Eastern Mediterranean Press was set up at Kephalo Bay, Imbros Island, in November, while the ship undertook various surveys, latterly in connexion with the evacuation of Suvla and Anzac.

THE PRINCIPAL SURVEYS OF 1916

HOME

Comber	*Daisy*	ENGLAND, EAST COAST	Thames estuary, The Downs, war operations
Gibbings	*Esther*	ENGLAND, EAST COAST	Thames estuary, the Medway, war operations
Reyne	*Hearty*	ENGLAND, EAST COAST	The Medway and the Humber, The Wash
Combe		SCOTLAND	Firth of Forth, Arran measured mile
Hancock, Douglas			War operations under the Chief of Admiralty War Staff

FOREIGN

Edgell	*Endeavour*	MEDITERRANEAN	Mudros, Stavros, Salonika
Haselfoot	H.M.S. *Humber*	MEDITERRANEAN AND RED SEA	Marsa Matruh and war operations
Maxwell	H.M.S. *Challenger*	AFRICA, WEST COAST	The Cameroons campaign

BY THE MARINE SURVEY OF INDIA

R.I.M. officers		PERSIAN GULF	War operations

The *Daisy* and the *Esther* were reallocated to surveying duties in May but were frequently employed on war operations. Hancock received the D.S.O. for surveying under gun-fire in Dover Naval Command.

The *Endeavour* came under the over-all direction of Douglas until June. Knowles and Woodhouse landed for surveying observations under gun-fire at Cape Helles immediately prior to the Gallipoli evacuation. Other detached parties maintained special navigational lights, which had been established for Fleet use. In April, the Eastern Mediterranean Press was transferred from Imbros to Mudros. A survey of Port Laki and the publication of the chart was completed in 27 days. Douglas, Edgell, and the officers and men received the marked approval of Their Lordships for their work.

From June, Douglas applied surveying methods to the bombardment of the Belgian coast by monitors; and he assisted in the design of rangefinding instruments for anti-aircraft defence.

Stevens and Tinson were in the Grand Fleet and both were promoted to commander.

Maxwell received Their Lordships' thanks and was made a Chevalier of the Legion of Honour for his surveying at Duala.

THE PRINCIPAL SURVEYS OF 1917

HOME

Jackson	*Daisy*	England, east coast	The Downs, operations in Dover Strait and on the Belgian coast
Gibbings, Maxwell	*Esther*	England, east coast	Medway and Thames estuary, minelaying operations
Reyne	*Hearty*	England, east coast Scotland, east coast	The Wash, river Swale Inverness Firth
Combe		Scotland, east coast	Firth of Forth
Lanyon		England, south coast	Plymouth and Portsmouth
Douglas, Edgell, Harvey			Operations under the Admiralty War Staff

FOREIGN

Hancock	*Endeavour*	Mediterranean	Malta's Grand Harbour, Port Kalloni, Mytilene, Gulf of Cassandra, Sollum and Alexandria Harbours
Haselfoot, Daugleish, Nares	*Enterprise*	Red Sea	Farisan Bank, Tiran Strait, Aqaba
		Mediterranean	Gaza

In the *Daisy*, Maxwell succeeded Gibbings in May, her surveys and those of the *Esther* being mainly for war operations including assistance to minelayers.

Mr J. H. Lanyon took charge of the south-coast-of-England survey, in which he had been an assistant.

Douglas left the War Staff in February to become director of the newly formed Naval Meteorological Service, created to meet the growing requirements of the Fleet and R.N.A.S. Formerly, the Hydrographic Department had served the Fleet's meteorological needs, and the R.N. Air Department had a section under Lieutenant A. E. Gendle, R.N.V.R. The incorporation of the latter in the department resulted in a far more efficient service.

The Eastern Mediterranean Press moved to Malta under Viney on the staff of the Commander-in-Chief, Mediterranean. The *Endeavour* detached two officers in a trawler to delineate the 100-fathom line from Port Said to Alexandria.

Haselfoot on the staff of the Commander-in-Chief, East Indies, had the *Enterprise* (550 tons) hired from the Sudan Government, and Daugleish made Red Sea surveys in her. Nares took command in September and the ship was employed in reconnaissance work and also acted as flagship for a week in the operations against Gaza. Thereafter, a survey of Aqaba was resumed.

THE PRINCIPAL SURVEYS OF 1918

HOME

Jackson, Harvey, Scott	*Daisy* *Esther*	ENGLAND, SOUTH COAST	Operations in Dover Naval Command
Reyne, Chearnley	*Hearty*	SCOTLAND, EAST COAST	Inverness Firth, Invergordon
		ENGLAND, EAST COAST	The Wash
Maxwell	*Melisande*	ENGLAND	South- and east-coast ports
Lanyon		ENGLAND, SOUTH COAST	Portsmouth

FOREIGN

Hancock, Reyne	*Endeavour*	MEDITERRANEAN	Port Trebuki, Skyros Island, Malta
Nares	*Enterprise*	RED SEA	Gulf of Aqaba, Farisan Bank, Tiran Island

In the *Daisy*, Jackson died on board at Dover on 7 March and was succeeded by Harvey. Haselfoot's work for the raid to block Zeebrugge and Ostend earned him the D.S.O. and the Belgian Order of the Crown; and he was promoted to commander.

Schafer was killed in H.M.S. *Gaillardia* in March when surveying for the Northern Barrage.

The *Endeavour*, when at Trebuki, had a trawler attached for an officer to delineate the 100-fathom line in the vicinity of Syra, Jura, Zea, and Lemnos Islands. Hancock lost his life when H.M.S. *Comet* in which he was taking passage was sunk in collision on 2 August. Reyne took command and, after certain operational work was cancelled owing to the armistice with Turkey and Bulgaria, *Endeavour* was employed for special duties with the Allied fleets in the eastern Mediterranean.

The *Enterprise* was hindered on the Farisan Bank survey by hostile Arabs under Turkish influence. Woodhouse took temporary command when Nares and two officers left in September to recommission the *Merlin* at Hong Kong.

Viney and Bright Barton were respectively in charge of the Fleet's printing facilities at Malta and Cairo.

THE PRINCIPAL SURVEYS OF 1919

HOME

Harvey	*Daisy*	ENGLAND, SOUTH COAST	Dover Harbour and off-lying wrecks
		SCOTLAND, WEST COAST	Gare Loch
Knowles	*Esther*	SCOTLAND, WEST COAST	Inverness
		NORTH SEA	The Northern Barrage
Chearnley, F. J. B. Gibson	*Hearty*	ENGLAND, EAST COAST	The Wash, Thames estuary
		SCOTLAND, EAST COAST	Moray Firth
Maxwell	*Melisande*	ENGLAND, EAST COAST	Rivers Colne and Blackwater approaches
Combe		SCOTLAND, EAST COAST	Rosyth and Granton
Lanyon		ENGLAND, SOUTH COAST	Portsmouth

FOREIGN

Reyne	*Endeavour*	MEDITERRANEAN	North coast of Egypt
Nares	*Enterprise* *Merlin*	RED SEA	Loheiya, Hurghada, Strait of Jubal
Glennie	*Mutine*	WEST INDIES	Bermuda—Hamilton Harbour, St George's Harbour, Ship Channel
Scott	*Fantôme*	AUSTRALIA, EAST COAST	Sydney, Port Jackson, Port Stephens

Tinson fixed the positions of the scuttled German High Seas Fleet at Scapa.

The *Daisy* also visited Lerwick in the Shetlands to fix experimental hydrophones. The *Esther* worked with a Trinity House vessel to lay light-buoys marking the Northern Barrage. The *Hearty* buoyed a minefield off the Yorkshire coast. The *Melisande* had continual engine-trouble and was returned to her owners after less than a year as a surveying vessel.

The *Endeavour* was assisted in her work by the Survey of Egypt, Cairo.

The *Merlin* having recommissioned at Hong Kong arrived at Port Said in January and completed her complement from the *Enterprise*, which was returned to the Sudan Government. Woodhouse, meanwhile, had been surveying Lake Timsah.

The *Mutine* was completed to full commission in June and until she was fit for sea, surveys were done from a drifter.

The *Fantôme* was reconditioned at Sydney after her war service with the Commonwealth Government, and meanwhile, surveys were done by detached parties.

APPENDICES

A

Admiralty Orders in Council

1. 1795. 12 August. Establishment of an Hydrographer's Department. *In extenso*: The great inconvenience which has constantly been felt by the Officers of Your Majesty's Fleet, especially when ordered abroad, from the want of sufficient information respecting the navigation of those parts of the world to which their services may be directed, and with which they are sometimes totally unacquainted, has led us to consider of the means most advisable to be adopted for furnishing such information, and for preventing, as much as possible the difficulties and dangers to which Your Majesty's Fleet must consequently be exposed from any defect on this head.

On a cursory examination of the plans and charts which have from time to time been deposited in the office, we find a considerable mass of information, which, if judiciously arranged and digested, would be found to be of the greatest utility to Your Majesty's Service; but from the want of a proper establishment for the execution of this duty, Your Majesty's Officers are in a great measure deprived of the advantage of these valuable communications.

In looking into the practice of all other countries less dependent certainly than this on the effect of naval operations, we find that considerable establishments have very wisely been formed for the purpose of attending to this important object, and it appears to us to be matter worthy of Your Majesty's consideration, whether it may not be advisable to adopt some similar plan.

In case Your Majesty should be pleased to view the object we have thought it our duty to point out to Your Majesty, in the same important light, we would humbly propose to Your Majesty that a proper person should be fixed upon to be appointed Hydrographer[1] to this Board, and to be intrusted with the custody and care of such plans and charts as now are, or may hereafter be, deposited in this office belonging to the public, and to be charged with the duty of selecting and compiling all such information as may appear to be requisite for the purposes of improving the navigation, and for the guidance and direction of the Commanders of Your Majesty's ships, in all cases wherever any knowledge in this respect may be found to be necessary.

The extent of this establishment not to exceed the sum of six hundred and fifty pounds per annum, in aid of which an allowance of one hundred pounds per annum, given to one of the clerks to our Secretary for his care of the plans and charts above mentioned, and of eighty pounds a year for the care of the office papers, will be applied so that the actual expense of this new establishment will not exceed four hundred and seventy pounds per annum.

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[1] The salary of the Hydrographer was, by an Admiralty Order of 11 September 1795, fixed at five hundred pounds per annum.

2. 1820. 20 OCTOBER. Establishment of the Observatory at the Cape of Good Hope.

3. 1828. 2 OCTOBER. Continued the offices of the Superintendent of Chronometers and Nautical Almanack, and the Resident Committee.

4. 1835. 30 SEPTEMBER. New establishment at the Royal Observatory, Greenwich.

5. 1838. 27 JANUARY. Warrant for the appointment of Visitors of the Royal Observatory. (Appointments included Captains Francis Beaufort and W. H. Smyth, being Fellows of the Royal Society.)

6. 1851. 7 MARCH. Harbour and Railway Department, increased salaries of the clerks and draughtsman. (The Harbour Department was reduced in December 1853 and placed under the Hydrographer and the establishment fixed at Engineer, three clerks, draughtsman and civil surveyor.)

7. 1862. 19 JULY. Establishment of Chart Branch of the Hydrographic Department. Referred to the position and pay of the Naval Assistants and Draughtsmen in the Chart Branch whose salaries have hitherto been provided under the Scientific Vote, their duties being the supply of charts and Sailing Directions, arrangement of surveys and the Tide Tables; and sanctions the establishment as a Chief Naval Assistant to Hydrographer, five naval assistants, Superintendent of Charts, six draughtsmen and four messengers. (The first mention of Chart Branch was in the Navy Estimates for 1854–55.)

8. 1864. 26 APRIL. Establishment of draughtsmen in Hydrographical Department. Amended one first-, two second- and three third-class draughtsmen to one chief, one first, two second and two third class.

9. 1865. 31 MARCH. Added to establishment of Hydrographical Department one Master or Staff Commander writing Sailing Directions and another as Curator of Original Documents.

10. 1865. 29 JUNE. Appointed to Hydrographical Department one Chief Naval Assistant and in charge of Magnetic Department and one Superintendent of Compasses.

11. 1865. 29 NOVEMBER. Hydrographer's salary increased from £800 to £1 000 in addition to half pay. Referred to increased duties and responsibilities occasioned by the transfer to his office of the hydrographic duties of the East India Government and the increasing requirements of modern science as bearing on his department.

12. 1866. 3 February. Salaries of Naval Assistants in Hydrographical Department. Civil salaries of first and junior assistants to be £600 and £450 respectively, the remaining five to be borne on a ship's books at full pay to which surveying pay should be added so that they shall receive £550, £500 and £450 respectively.

13. 1867. 19 March. Transfer of duties in connexion with pilotage of the Royal Navy. Mr Dimsey from Accountant-General's department to that of Hydrographer with increase of salary.

14. 1875. 12 October. A Treasury Letter. One additional naval assistant approved. It asked if additions approved the previous year had been carried out and if the Indian Government had undertaken to defray the additional expenditure.

15. 1879. 29 November. Authorization for the Lords Commissioners of Admiralty with concurrence of Her Majesty's Treasury to make changes in Civil Departments of the Admiralty.

Note.—Admiralty Orders in Council are kept in bound volumes in the Naval Library. There is also a collection of those affecting the Hydrographic Department in the report of the 1883 committee (see Appendix C, 4).

B

Admiralty Records in the Public Record Office

1. 1795–1809. Letters relating to the Business of the Hydrographic Office are separately filed in packages Adm.1/3522 and 3523. There are letters from Dalrymple, the Chart Committee, and Hurd. Action authorized by the Secretary of the Admiralty was customarily written by him on a turned-up corner of a letter.

A third package covering 1810–1817, Adm. 1/3524, is almost entirely concerned with administrative details of chart supplies through the dockyard ports.

2. 1809–1837. Admiralty Digests. Volumes were compiled in manuscript for periods of a year with a Section 57 for the Hydrographer and Section 58 for the Board of Longitude. Details include the source and summaries of letters or reports to the Admiralty and Their Lordships' decisions thereon. Indications are given of the packages in which the original may be found. Reference to such packages is not always successful and for instance Board minutes were not filed. Surveying ships' proceedings were reported to the Admiralty and should be available though not consulted for this book.

(Hydrographic Department records—see Appendix C—gradually became more complete from 1825 onwards and the use of Admiralty digests as a source ceased from 1837. Admiralty digests continue and documents are filed in accordance with the Public Records Act, 1958.)

3. 1804. 6 February. A final proof of a printed Admiralty circular letter sent to Dalrymple for agreement, and found in Adm. 1/3522, reads:

> My Lords Commissioners of the Admiralty judging it highly important to the advancement of Nautical Knowledge, and to the safety of H.M. Ships that the reports on Coasts, Harbours etc., which the officers of H.M. Navy are directed to transmit to this office, should be made with every possible degree of correctness, and that they should contain all the information that circumstances will admit of; I am commanded by Their Lordships to signify their direction to you, to be as particular as possible in your Remarks on the Coasts, Harbours etc., which you may visit from time to time in future, and to transmit Reports thereof to this Office, agreeably to the enclosed Form, by the first safe conveyance, retaining a copy of such Reports in case of accident; and you are desired to give your opinion of the Track most advisable to be pursued, in passing to and from different places, according to the different Seasons of the Year, whenever your experience has enabled you to form such an opinion; In doing this, you will refer to the Ship and Year

> when that experience was acquired. Their Lordships have given directions to the Hydrographer of this office to examine such Reports, and to state to them, how far they appear to him to have been made with a due attention to the Objects of these Instructions.
>
> I have Their Lordships further commands to signify their direction to you whenever you may capture any Ship or Vessel beloning to the Enemy, to secure All Journals, Nautical Descriptions, Charts, Plans, Maps and Views of land which may be found on board her; take an exact Inventory, and transmit the same to me for Their Lordships information as speedily as possible; and you will send to me by the first said conveyance the said Journals, Nautical Descriptions, Charts etc., for the use of the Hydrographical Office which when they have been copied will be returned to you.

The enclosure entitled ' Form of Remark Book ' gave six pages of the details required.

4. In addition, the following copy of an Admiralty letter, unsigned, regarding the provision of hydrographic information is presumed to have been issued about 1760. The evidence is the incomplete year-date 17 . . ., a reference to war taken to be the Seven Years War, and a mention of Michelot, whose portolan was published in 1754.

> By the Commissioners for executing the Office of Lord High Admiral of Great Britain and Ireland, etc.
>
> The King's Service having suffered very much during this War for want of due Information and Knowledge of Harbours, Roads, and accessible places on the Coast of France, the Journals of the Ships which have been employed in cruising upon the Coasts of that Kingdom being found defective, and not to contain the necessary Lights which ought to have been transmitted therein: And it being just and reasonable, that the Public and Posterity reap the Fruits of the Experience of the present Age, and that Navigation should owe its Improvement to the Nation, and to those Officers who are acknowledged to excel all other in the Practice of it:
>
> You are, for these Reasons, and that this Board may be furnished with all useful Information of the State of Foreign Coasts, Ports, and Roads, and all others where the King's Ships may arrive, hereby strictly required and directed wherever you shall Anchor (but more particularly when it shall happen in Foreign Ports and Coasts) to exert your utmost Diligence in making the most accurate Observations you possibly can of the Latitude and Longitude; of the Variation of the Compass; concerning the Sands, Shoals, Soundings, Sea-Marks, dangerous Winds to ships at Anchor, Roads, Bays, Harbours, Time of High Water, and Setting of the Tides; together with the Depths of Water at the Time of Spring and Neep Tides; with the best Directions for sailing into Ports, or Roads, and for avoiding Dangers, and whether they require Pilots, and where to be had; also the best Anchoring Places, Landing Places for Troops, and Watering-Places, describing the best Methods for Watering, and Wooding, and whether these are in such Plenty, as to supply Fleets; noting likewise what Provisions of Wine and Refreshment may be had for the Sick and Ships.
>
> You are also to take notice of the Setting of Currents, and the Winds that prevail on the Coasts.

You are likewise, in the best Manner you are able, to describe Fortifications, noting, in as particular a Manner as you possibly can, their Form, Strength, and Situation, and in what Manner they cover and command the Places where Troops may land, Anchoring-Places and Watering-Places, and how far they are, or are not, attackable by Ships and Bomb-Vessels: And where there shall be Artists on Board, properly qualified, you are to add Drafts, and Plans, for the better Illustration of the above Particulars, with proper References and Explanations. And, that the aforementioned Matters may be at any Time recurred to by this Board, in as expeditious a Manner as may be, the Master of the Ship or Vessel you command, is hereby required to keep a Book, in Folio Paper, for the said Purposes only, and to enter therein the above Particulars under your Inspection; and you are very carefully to supervise him in doing the same, and cause him to add, at the End of the Book, an Index of the Names of Places mentioned therein, referring to the Page of the Book in which they are mentioned.

You are to comply with the aforegoing Directions, not only with respect to the Coasts, Harbours, Roads, and Places belonging to all Foreign Potentates, but likewise with respect to all the Coasts, Ports, Bays and Roads, of Great-Britain and Ireland, and their adjacent Islands; and moreover with respect to the British Islands, Colonies, Settlements, and Plantations, in all Parts: And you are to appoint your Master, with such Officers and Youths of your Quarter-Deck as you shall find best disposed and qualified to make the Surveys and Observations above-mentioned; taking however particular Care, when in Foreign Parts, not to do any thing to give Umbrage or Offence to the Governors, or Inhabitants, of Places in Friendship with the King.

And, as we have the greatest Opinion and Confidence in the approved Zeal, and becoming Emulation, of the Officers of the Navy in general; we therefore expect a very punctual and careful Performance of what is here prescribed, which may be of the greatest Importance to the King's Service; and do not doubt but they will use their best Endeavours to promote a Design so useful to Navigation, and so honourable to themselves.

But if, contrary to our Expectations, any should be so remiss and inattentive as to fail to comply with the afore-said Directions, let it be observed, that we have directed the Navy Board, not to make Payment of Wages to Captains, and Masters, till they shall have satisfied this Board of their Reasons for not having complied with these our Directions, or shall produce a Certificate, signed by our Secretary, of their having done so to our satisfaction.

Given under our Hands the of 17. . . .

By Command of Their Lordships.

Explanations

The Form given on the Other Side will contain all the Remarks that are required. The Harbours, Roads, etc, on the Coast of Great Britain and elsewhere, although They may be described by Collins, and other coasting Pilots, yet, as many Omissions may be discovered, and Amendments made in those Books, it is therefore required, that all Places whatever where Ships may anchor, as well upon our own Coasts as others, shall be set down in this Book, with the Addition of such Remarks as you may have Time to make. This however is not required for Harbours where local Pilots are used.

The Ports in the Mediterranean are also accurately described by Michelot; but as his Remarks do not do to the full Extent of this Plan, you are required to add such farther Observations as are pointed out by the annexed Form.

The Islands, Keys, etc., in the East and West Indies, the Harbours, etc., in our own Plantations and Colonies, and those of other Nations, furnish a large Field for such Observations as are here required. The Navigation also to those Colonies, the Coasts of Africa and India afford Occasions to remark the Currents, Trade Winds, and Variation of the Compass, etc.

The Fortifications also, and Strength of Foreign Settlements, ought in particular to be taken Notice of, and likewise those of our own Nation, as well as of others, on the Coast of Africa, etc. But as to the Descriptions here required of Fortifications and their Situations, it is not expected that all the Officers of the Navy are qualified to judge accurately of these Points, and it is therefore expected only, that they describe, to the best of their Judgments, how far they may be attacked, and in what Manner they defend Watering and Anchoring Places. Their Observations will become more perfect as they apply their Thoughts to these Matters, and consider the Distance and Force of Shot fired from Cannon and Musketry, and the Range of Shells fired from Sea Mortars.

Draughts, if too large for this Form, may be made up in another Book and be referred to in this.

Remarks upon Coasts relate to Winds, Tides, Currents, Soundings, Anchoring Places, and Head Lands.

Remarks upon Trade, Shipping, and Ceremonials, are required, according to the best Information that can be got; noting upon what Information the same is founded.

All Places whatever, where Ships shall anchor, are to be noticed in this Book, and the Time of their Stay in each.

Such as are described in Books of Pilotage, are nevertheless not to be omitted. Those Books may be referred to, and their Descriptions confirmed or amended.

[*Note.*—A further search of the Hydrographic Department's historical records could well produce evidence of the material sent in as a result of this letter.]

C

Hydrographic Department Records

1. 1804–1857. In-letters from all sources, including many from surveyors, numbered and filed in boxes.

2. 1815–1896. Letter-books. 1825–1912. Minute-books. Letters and minutes were copied into these books by the clerk. There are also surveyors' letter-books, containing out-letters to surveyors, continuing to 1916, and Confidential Minute-books Nos 1–3, 1899–1911, No. 4 being missing.

3. Indexes of the above material up to 1905 (except letter-books from 1897 onwards) were prepared by L. A. Luff, m.b.e., in 1956–58 as follows:

(*a*) *In-letters.* An index showing only the number given to the letter, the name of the writer, and the year in which the letter was written.

(*b*) *In-letters, Out-letters and Minutes.* (*i*) A *chronological* index of selected items, giving the date, the name of the writer, the subject-matter with summary of contents where applicable, and cross-reference to other letters and minutes on the same subject. (*ii*) A *personal* index listing the same selected items under the names of the writer and the names of other persons, or both, when appropriate. (*iii*) A *subject* index of the same selected items grouped together under subjects, where this was possible.

Their coverage is extensive but not complete, the objective being to make possible the tracing of an original of historical importance.

The chronological indexes comprise Book I 1801–60, Book II 1860–97, and Book III 1897–1905.

4. 1800 *et seq.* Other material that had accumulated in Sailing Directions Branch rather than the registry was searched concurrently by G. B. Stigant, o.b.e., and collected into two systems of files:

(*a*) *Surveyors' Letters* personally to the Hydrographer of which there is a general index to 114 files, 1791–1866.

(*b*) *Miscellaneous Letters and Reports* on a great variety of subjects of which there are general and detailed indexes to fifty-five files over the same period.

Notably there are some papers bequeathed by J. F. Parry. Misc. 5 includes original Board minutes of 1819, 1825 and 1827 on departmental organization with supporting letters. Misc. 4 contains Gould's draft Chapters 1 and 2 of a Hydrographic Department history that gives a colourful account of the early difficulties from 1795 to 1829; and correspondence indicating how it came to be left incomplete.

In Misc. 52 there are: 1868, *A Memoir of the Hydrographical Department of the Admiralty* by Richards; 1883, 1905 and 1913, reports of committees on the department; 1919, reports of work in 1914–18; 1939–45, report of war work. Stigant's notebooks are also in the records.

5. 1822–1882. SOME PAPERS held by Issues Division of the department concerning chart sales from 1823 and the institution of a sole chart-agent in 1830. There is a copy of a Marine Department (Board of Trade) paper recapitulating their efforts between 1851 and 1882 to ensure that merchant vessels held correct charts.

6. 1833 *et seq.* HYDROGRAPHIC DEPARTMENT PUBLICATIONS. A list of these numbered publications and also an almost complete record set of them is in the department's archives. They comprise reports on deep-sea sounding cruises and methods; visits to oceanic islands and the collection of scientific information; meteorological, geophysical, and tidal phenomena; currents in various straits; navigational developments, including terrestrial magnetism and the compass, astronomy, and tides. Additionally, there are reports on special surveys and methods.

7. 1912–1922. A SYSTEM OF DOCKETS with supporting bound indexes, of which the 1915–16 index is missing.

8. 1922 *et seq.* A SYSTEM OF JACKETS with bound source indexes.

9. 1891–1920. ESTABLISHMENTS OF SURVEYING SHIPS.

10. 1897 *et seq.* ABSTRACTS OF SURVEYORS' SERVICES, giving biographical information.

Note.—Original survey documents and copies of published charts, Sailing Directions, Tide Tables, Light Lists, Notices to Mariners are preserved in the department. Details of original documents, which are held in agreement with the Public Record Office, are given in Hydrographic Department Professional Paper No. 13 of 1950, *A summary of selected Manuscript Documents of historic importance preserved in the Archives of the Department.*

D

Instructions for the Hydrographer

Admiralty, January 1889

1. The Hydrographer is responsible to their Lordships for the correct performance of the duties of the Department of which he is the head, and for the efficient working thereof, including the arrangement of the duties of the Staff. He is to keep the Superintending Lord fully informed of everything of which he ought to be made aware in connection with his Department, and in all matters of importance he is to obtain superior authority. In all matters committed to his charge he will keep in view the necessity for organization to meet the condition of war.

2. He is to recommend to their Lordships, from time to time, the undertaking of such nautical surveys as he may consider necessary for the security of Her Majesty's Ships and the Mercantile Marine in all parts of the world. He is responsible for the accurate execution of such surveys, and also for obtaining and publishing information respecting navigation, as well as for the construction and publication of Charts, and Nautical Directions to accompany the Charts. He is to compute, prepare, and publish annually, Tide Tables and Light Lists for all parts of the world. He is responsible for the printing and sale of Charts.

3. He is to keep Her Majesty's ships and Naval Establishments supplied with Chronometers, and with Charts, Tide Tables, Light Lists, Nautical Almanacs, and such other similar publications as may from time to time appear desirable. He is to see that the number of Charts and Nautical Directions printed is sufficient to meet the demands of the general public. These Directions are to be sent to Her Majesty's Stationery Office to be printed, and such copies as are required by him are to be demanded therefrom.

4. He is to exercise superintendence over Officers of Her Majesty's Navy and others employed in surveying, as far as relates to performance of surveying or scientific duties; he is to report any cases of praiseworthy conduct, or any instances of neglect of duty. He is to advise their Lordships concerning the position, appointments, and employment of Officers in the Surveying Service.

5. He is responsible for the preparation of the estimates, and for the general control of the expenditure under the scientific vote, so far as relates to his Department, and for keeping a due record of expenditure and liabilities relating thereto. Particular care is to be taken that the Regulations established by their Lordships to secure financial order and control are duly observed.

6. He is to provide a stock of, and supply to all Surveying Ships, such instruments and special stores as may be necessary for the duties on which they are to be engaged.

7. He is not to utilize, without the express sanction of their Lordships, savings arising from reduction in prices, or in anticipated requirements, by purchasing supplies of stores beyond the quantities provided for in the Navy Estimates.

8. He is responsible for the proper examination and accuracy of all accounts of stores and materials under his charge. He is to prepare such periodical statements of Store accounts for the information of the Financial Secretary as may be directed, and furnish the Comptroller and Auditor-General and the Public Accounts Committee with any explanatory information that may be called for in connection therewith.

9. Whenever one of Her Majesty's ships is selected to be prepared for Surveying Service, he is to inform the Controller of the Navy what special fittings he considers necessary to render her fit for the expeditious prosecution of the work upon which she is to be employed.

10. He is to demand from Her Majesty's Stationery Office such stationery and drawing materials as may be required for his Department and the Surveying Service.

11. He is responsible for all matters connected with compasses of Her Majesty's Ships, including general arrangements for the fitting of these instruments; also for the record and examination of Tables of Deviation.

12. He is the medium of communication with the Meteorological Office, and is to regulate the supply of Meteorological Instruments to Her Majesty's Ships and Naval Establishments.

13. He is to superintend the examination of Officers in Pilotage.

14. He is to advise their Lordships on all matters connected with the Royal Observatory at Greenwich and the Observatory at the Cape of Good Hope, both as to their internal economy and the management of their Staff. Also as to Scientific Expeditions, and scientific questions upon which he may be able to furnish their Lordships with information or opinion.

15. He is to advise their Lordships on all matters connected with the Conservancy of the Harbours, Waters, or Shores under Admiralty jurisdiction.

16. Questions relating to Pilotage, including expenditure, are to be dealt with or reported upon by him. He is to advise their Lordships on all navigational questions, particularly all cases of grounding of Her Majesty's Ships.

17. He is to take charge of, and examine, the Remark Books transmitted to the Admiralty by the Captains and Navigating Officers of Her Majesty's Ships, and is to report to their Lordships any facts he may consider worthy of notice.

18. On all questions of detail relating to the duties of his Department and the Surveying Service, he is to correspond in his own name both with Officers employed on Surveying duties under him, and with Officers of Her Majesty's Naval, Civil, and Consular Services, Hydrographic Authorities of Foreign Countries, and Public and Scientific Societies and Establishments; but all correspondence in the name of the Board is to be signed by the Secretary.

By Command of Their Lordships,

EVAN MACGREGOR

E

Senior Officers, Hydrographic Department, etc.

Chronological List

HYDROGRAPHERS

1795 Dalrymple; 1808 Hurd; 1823 Parry; 1829 Beaufort; 1855 Washington; 1864 Richards; 1874 Evans; 1884 Wharton; 1904 Field; 1909 Purey-Cust; 1914–19 Parry.

CHIEF NAVAL ASSISTANTS, ASSISTANT HYDROGRAPHER

The title of Assistant Hydrographer was used by J. Walker from 1823 and M. Walker from 1831 and the first formal appointment was of Chief Naval Assistant in 1862, Becher, who had been the first Naval Assistant in 1823. Then, 1866 Evans; 1874 Pender, the title changing to Assistant Hydrographer in 1883; 1891 Tizard; 1907 Purey-Cust; 1909 Monro; 1910 Parry; 1914–19 Hardy.

From 1909 there was also an Assistant Hydrographer (N), Miller; 1912 Nelson-Ward, who in 1913 became Director of Navigation Department; 1916 Webster as Assistant Director when Navigation again became a branch of the Hydrographic Department.

SUPERINTENDENT OF CHARTS

1862 Bedford; 1865 Hoskyn; 1873 Hull; 1879 Stanley, when the title became Officer-in-Charge, Chart Branch; 1906 Pasco; 1908 Learmonth, when the title of Superintendent of Charts was reassumed; 1909 Glennie; 1910 Douglas; 1915–23 Nares.

CHIEF DRAUGHTSMAN, CHIEF CARTOGRAPHER, ASSISTANT SUPERINTENDENT OF CHARTS

1800 J. Walker, succeeded by M. Walker in 1831, superintended engravers and draughtsmen and latter was chief draughtsman from 1856 to 1861 when the title lapsed until 1864 Hoskyn; 1865 Powell; 1892 Boyle; 1900 Clark joined 1905 by Gibson. The title became chief cartographer in 1909 and three were established, Gibson, Briggs and Underhill; 1911 Codd succeeded Briggs; 1917 Underhill was given the title of Assistant Superintendent of Charts.

CURATOR OF ORIGINAL DOCUMENTS

In 1823 Becher was appointed temporarily as the first naval assistant and in

1826 Croker, the Secretary, accepted his report on the cataloguing and indexing of original documents. In 1865 Davis took over from Becher and the title Curator was instituted. From 1876 to 1883 the holder has not been identified but in the latter year it was Gibson, a draughtsman, with an allowance of £25. There followed: 1905 Underhill; 1909 Codd; 1911 Sharbau (probably); 1914 Mackenzie until 1945.

SUPERINTENDENT OF SAILING DIRECTIONS

Sailing Directions were begun in 1828 by Dessiou and Rae and continued by various naval assistants, e.g. Burdwood (1849), Dunsterville (1854), Penn and McDougall (1870), and Richards (1874), who received an allowance from 1883, followed by Langdon (1903). In 1909 the title of superintendent was established, with Monro also undertaking duties of Assistant Hydrographer; 1912–19 C. V. Smith.

JACKETING OFFICER

The officer handling incoming hydrographic papers in Sailing Directions Branch became known as Jacketing Officer in 1907 C. V. Smith; 1908 Pearson; 1911 Bell; 1919–29 Bright Barton.

TIDAL WORK

Tide Tables were begun in 1833 by Ross; 1854 Burdwood; 1870 Davis; 1876 to 1912 an unidentified naval assistant; 1913 Warburg as officer in charge of Tidal Work, and he became Superintendent of Tidal Work in 1917.

NOTICES TO MARINERS OFFICER

Notices to Mariners were begun in 1854 but no naval assistant was specifically employed until 1874 H. R. Harris; 1893 Goalen; 1898 Havergal; 1908 Brooke-Webb; 1914–28 Grant.

LIGHT LISTS

A Light List was first issued in 1827. Thereafter various assistants undertook compilation and in the period covered it is only known that W. T. P. Wilson was the Light Lists Officer from 1912 to 1920.

NAVAL METEOROLOGY

In 1917 Douglas was appointed director of the newly-formed Naval Meteorological Service and in 1918 he was succeeded by Glennie as superintendent of the Admiralty Meteorological Service.

CHIEF CIVIL ASSISTANT

The first Chief Civil Assistant was appointed in 1880, Blakeney being succeeded in 1882 by G. W. Underhill, both paymasters. Then Frederick, 1897, and J. F. Parry, 1901, were surveying officers and Barber (1903–22) was the first civilian holder of the appointment.

SUPERINTENDENT OF CHART ISSUES

Llewellyn was the first superintendent in 1917, having been in charge of the branch since 1912, previous to which the responsible officers were naval assistants. There was first mention of a branch in 1888 but those concerned before and after have not been identified until 1912.

PROFESSIONAL OFFICER, formerly MEMBER, AT THE BOARD OF TRADE

The post was instituted by the Mercantile Marine Act of 1850 for a naval officer, there being a second Merchant Navy officer. 1850 Beechey; 1856 Sulivan; 1865 G. A. Bedford; 1879 Nares; 1897 Vereker; 1900 Frederick; 1910 Monro to 1927.

ASTRONOMERS ROYAL, Greenwich

1675 Flamsteed; 1720 Halley; 1742 Bradley; 1762 Bliss; 1765 Maskelyne; 1811 Pond; 1835 Airy; 1881 Christie; 1910 Dyson to 1933.

H.M. ASTRONOMERS, Cape of Good Hope

1820 Fallows; 1832 Henderson; 1833 Maclear; 1870 Stone; 1879 Gill; 1907 Hough to 1923.

SUPERINTENDENTS OF H.M. NAUTICAL ALMANAC OFFICE

1818 Young; 1829 Pond as Astronomer Royal; 1831 Stratford; 1853 Hind; 1892 Downing; 1910 Cowell to 1930.

SUPERINTENDENT OF COMPASS BRANCH

1842 Johnson; 1853 Brunton; 1855 Evans who in 1866 combined i/c Magnetic Branch with Chief Naval Assistant; 1874 Mayes; 1887 Creak; 1905 Chetwynd until 1911 when the branch became a department separate from the Hydrographic Department.

F

Tabulated Statistics: 1795-1920

Year	*Naval staff*	*Draughtsmen/ cartographers*	*Secretarial*	*No. of navig. charts in cat.*	*No. of new navig. charts*	*No. of ord. N. to M.*	*Chart printings—all purposes*	*Rcpts from charts sales*	*No. of surv. units*
1795	1	1							
1800	1	3							
1810	1	4	3						2
1820	1	4	1					£72 (1823)	9
1830	4	4	1	850	19				14
1840	6	4	—	1 120				£461	19
1850	6	4		1 981 (1855)	79	50 (1854)	32 000	£1 010	22
1860	7	5		2 500 (1864)	199	153	140 000	£5 000	22
1870	9	6	1	2 619 (1875)	100	280		£4 550	12
1880	10	6	1		58	294		£7 400	12
1885	11	7	3	2 683	54	254	272 115	£8 295	13
1890	13	9	4		76	727	297 120	£10 020	12
1895	13	11	4		114	738	312 638	£10 670	11
1900	13	11	4	3 089	102	874	580 207	£22 262	12
1905	13	13	8	3 437	110	1 392	689 930	£25 534	12
1910	13	26	9	3 650	45	1 809	504 231	£24 468	12
1913	13	26	9	3 591	50	2 030	1 514 667 (1914)	£45 170	12
1920	14	16*	4*	3 546	32	2 137	1 190 809	£96 984	11

Notes.—(i) The total staff, including nine packers and messengers, reached 50 in 1907, and after passing a peak figure during the 1914–18 war, it was about 350 in the 1919–20 Estimates. At the latter date it included some printing tradesmen; and the figures (*) in columns three and four for 1920 include only cartographers and senior administrative staff respectively.

(ii) The number of surveying units in home waters suffered a cut of six in 1853 but built up again to the maximum of 24 in 1862. By 1870 many home surveying parties were no longer needed and thereafter the number of units remained around twelve. The number of surveying officers afloat was about 70 in 1862. Between 1870 and 1904 it was about 45 and by 1910 it was 65.

(iii) Chart printings reached a peak figure of 2 598 455 in 1919.

(iv) For purposes of comparison some figures for 1963 were:

Naval staff, 24; civil hydrographic officers, etc., 45; draughtsmen, 119; secretariat and chart correcting, 140; printing, etc., 360; paperkeepers, messengers, 56. Total 744.

Number of navigational charts catalogued, 3 381; new navigational charts, 61; Admiralty Notices to Mariners, 2 750; chart printings, 2 067 175; chart sales, £419,107; survey units, 12.

BIBLIOGRAPHY

I

Naval Publications and Compilations in the Naval Library

1. 1680–1870. LIST OF THE NAVY. Booklets containing manuscript particulars of H.M. ships such as dimensions, where and when built or acquired and their disposal. For example, the volume for 1810–15 shows the surveying vessels *Sorlings*, *Gleaner*, *Investigator*, and *Sydney*.

2. 1814 *et seq*. THE NAVY LIST. The introduction to the first volume refers to ' the first number of the first authenticated *Navy List* ever published '.

Up to 1854 the name of the Hydrographer was shown under 'Admiralty Office'. Names of the ' Commissioners for the discovery of Longitude at sea ' appeared from 1819 to 1829 and of the Astronomer Royal, Cape Astronomer, Superintendents of Nautical Almanac and Chronometers from 1821. Surveying ships were indicated as such from 1816. In 1831 there is reprinted the order signed in 1830 by the Secretary of the Admiralty, which read:

> The Lords Commissioners of the Admiralty being desirous to extend the benefit of marine surveys which have been made for the use of H.M. Navy more generally among the Mercantile Shipping of the Empire have appointed Mr R. B. Bate, 21 Poultry, London, to be Their Lordships' agent for the sale of charts published under Their Lordships' orders . . . all corrections will be notified to the agent so that the latest information may be available. . . .

From 1857 there was a nominal list of personnel with the appointments they held in the Hydrographic Department. From 1864 there was a list of officers employed on surveying service by name, rank, ship, and station to which the grades of the assistants was added in 1925. Details of surveying pay were given in 1865.

3. 1810 *et seq*. NAVY ESTIMATES. From 1810–30 in the section on civil offices the Hydrographer's salary (£500) was shown and 'Contingencies relative to the Service whereon the Hydrographer is employed' (£150 rising to £4 000).

In 1831 under the Scientific Branch together with the Royal and Cape Observatories was shown the Hydrographical Branch as follows:

	£
Hydrographer	500
Four assistants	485
Four draughtsmen	793
Porter and repairer of charts	78

Assistant porter and repairer of charts		47
For purchasing charts, for engraving, printing and mounting charts and various other contingencies		1 097
To Captain W. H. Smyth for his prepared charts and plans of the Mediterranean		500
For the hire of vessels and boats, lodging money and various expenses relating to coast and other surveys at home	£ 3 600	
For extra pay to surveyors and their assistants in ships at home	821	
		4 421
For extra pay to surveyors and their assistants in ships abroad ..		1 825
Total		£9 746

This amount of detail gradually increases and considerable information becomes available from this source on the department's staff and activities, the activities of the surveying service and its cost.

4. 1813 *et seq*. NAVAL REGULATIONS, *K*. (or *Q*.) *R.A.I.*, etc. In 1813 Article V referred to Remark Books and announced that no certificate for them would be granted 'until Hydrographer shall have reported on their content'. Article XXV gave the arrangements whereby commissioners at dockyard home ports held and issued sets of charts in boxes and an Instruction of 1824 added details on these chart supply arrangements. Surveying pay, use of surveying ships by commanders-in-chief and so on are found in later editions, e.g. 1833.

5. 1828 *et seq*. ADMIRALTY CIRCULAR LETTERS (*A.F.O.s*). 1828; 28 June; signed by the Secretary, Croker:

> I am directed by His Royal Highness the Lord High Admiral to direct that you will in future invariably construct your charts sent to the Office for engraving upon one of the five following scales according to the nature of the Coast, Harbour, etc., without regard to uniformity in the size of paper.

General Charts	1½ in.	to a degree of longitude
Portions of coast	¼ in.	to a nautical mile
or	½ in.	ditto
Particular plans	1½ in.	ditto
or	3 in.	ditto

> . . . you will in future transmit together with the fair Charts above mentioned the rough Charts also showing the whole of the triangulation employed in the course of your work and giving so explicit an account of your mode of proceeding and of determining the several Bases, as may enable His Royal Highness to judge of the degree of confidence that may be placed in the accuracy of your several surveys.

1832. 26 December. Attention was drawn to the unsatisfactory state in which chart sets were being returned.

6. CIRCULAR TO ADMIRALTY CHART AGENTS. H.O. Admiralty, 5 February 1861:

> The Lords Commissioners of the Admiralty being desirous to take steps for ensuring that the Admiralty Charts in the hands of the several Chart Agents be kept corrected up to the latest date, and with a view to placing the sale of the Admiralty Chart generally on a better footing, so as to render them more accessible to the public, have sanctioned the following Regulations, a copy of which is here transmitted for your guidance.
>
> (1) The Admiralty charts are to be sold at the prices engraved respectively on the face of them.
>
> (2) The charts in future will be supplied backed and labelled, and the lights coloured and no charge is to be made for the backing.
>
> (3) A commission of 33 per cent will be allowed on sales which is to cover all expenses.
>
> (4) Printed copies of Notices to Mariners respecting new or altered lights, and Hydrographic Notices of any shoal, or rock, or channel discovered that affect your neighbourhood will, in future, be transmitted to you as soon as published at the Admiralty. All those printed since the beginning of the present year are sent herewith.
>
> (5) Immediately on the receipt of such Notices you are to employ a *competent* person to insert neatly the necessary correction in each copy of the chart affected by it that may be in your possession. In the case of a new light it is to be coloured as are the other lights in the charts.
>
> (6) You are strictly enjoined not to sell a copy of the chart in question until this has been done. And you are also to give the purchaser a copy of the notice and to call his attention to the correction.
>
> (7) In order to facilitate the insertion of the above corrections, the Titles and numbers of the charts affected are marked on each Notice. Generally speaking a single copy of a chart can be corrected in a few minutes. When the corrections are extensive the chart will be cancelled and a new chart will be sent to replace it.
>
> (8) Cancelled charts are in all cases to be immediately returned to the Principal Chart Agent in London when their cost will be allowed for.
>
> (9) A moderate charge for time employed in correcting the charts may be deducted from the account of sales and accounted for in the bill.
>
> (10) You are to stamp or paste upon the face of every chart a label containing your name and address, and write in the date on which it is sold.
>
> (11) You will place in some conspicuous part of your premises a board or placard with the words ‘ Agent for the Sale of Admiralty Charts ’, painted thereon.
>
> By command of their Lordships, JOHN WASHINGTON, Hydrographer.

On 1 April to each agent listed in Sailing Directions:

> Sir, I enclose a copy of a circular containing Regulations respecting the sale of Admiralty Charts to which I have to request your special attention. I have further to request that you will do your utmost to keep the charts corrected up to the latest date and will inform me immediately of any inaccuracy that any of your customers may point out or that may otherwise come to your knowledge.

7. MEMORANDUM NO. 9 P: SURVEYING PAY AND ALLOWANCES.

My Lords Commissioners of the Admiralty are pleased to direct that the following Regulations relating to Surveying Pay and Allowances shall take effect from 1st January 1862.

Rank	*Pay per day*	
	At Home	*Abroad*
Captain or Commander when in charge of survey	13/6*d*	20/–
Lieutenant or Master ditto	10/–	15/–
Assistant Surveyor of the first class	7/–	8/–
,, ,, second ,,	5/–	6/–
,, ,, third * ,,	3/–	4/–

* to commence after one year's service provided the officer in charge reports that the assistant has become useful.

Officers appointed to Surveying Vessels from half pay are not to begin to draw their surveying pay until they shall have reached their respective stations.

Officers transferred from one survey to another for the benefit of the service (and not at their own request) are to continue their surveying pay without a break; but if going abroad with a higher rate of pay, such higher rate is to commence only on their reaching the new station.

Officers returning home from a foreign survey are to retain their surveying pay and allowances until their ship is paid off, or if returning as passengers up to the date of their quitting their surveying ships.

Officers engaged in compiling Sailing Directions or in preparing Tables of Positions or in other bona fide hydrographic work will receive 10/– per day of six hours for the time so employed.

The travelling expenses of officers transferred from one survey to another for the benefit of the service will be allowed them. But not when they change from one survey to another for their own convenience, or go on leave.

The allowance for Lodging and Subsistence will be paid to Surveying Officers under the Regulations and according to the scale laid down in the Admiralty Instructions, an exception being made in the case of Officers employed on the West Indian, Cape of Good Hope and Australian Stations, who will be granted 2*s* 6*d* a day in addition to the established allowance.

During the summer (generally for about seven months of the year) when officers are actually embarked and at sea with hired crews, the lodging allowance will cease. Some of the hired vessels, however, are so small that officers cannot live on board, in which case they will retain their lodging allowance.

An allowance for wear and tear of clothes will be made to the crews of Surveying vessels in cases in which it shall be certified that from the nature of the coast, etc., extraordinary expense of clothing has been incurred.

By command of Their Lordships. C. Paget.

To all Commanders-in-Chief, Captains,
Commanders, and Commanding Officers of
Her Majesty's Ships and Vessels.

2

Hydrographic Department Publications and Reports in the Naval Library

1. 1825 *et seq.* CATALOGUES OF CHARTS, etc. The title-page of the first issue in 1825 (reproduced on p. 40) read:

> A Catalogue of Charts, Plans and Views printed at the Admiralty Office, for the use of His Majesty's Navy; and now sold (wholesale and retail) for the use of Navigators in general, by the Undermentioned Agents:
>
> J. Wyld, Geographer to His Majesty, Charing Cross; A. Arrowsmith, Hydrographer to His Majesty, Soho Square; Messrs Norie & Co., 157, Leadenhall Street; Kingsbury, Parbury and Allen, Leadenhall Street; R. H. Laurie, 53, Fleet Street; and by Messrs. J. & A. Walker, Pool Lane and T. Jones, 5, Harrington Street, Liverpool.

In 1830, the reference became: ' constructed under the orders of the Lords Commissioners of the Admiralty . . . with the prices at which Their Lordships permit them to be sold by R. B. Bate, Poultry, London '. In 1839 the line read: ' published by orders of . . .'.

Comprehensive and valuable information on the then state of surveys becomes available in 1839 when charts were listed with a number, size, scale, title, source, date and also price. In 1913 the source disappears but the date of publication is given.

Publication of the catalogue was not made annually until 1886, but gaps of two years or more only occurred in 1833–38, 1842–45, 1850–51, 1853–54, 1858–59 and 1873–74.

2. 1851 *et seq.* ADMIRALTY SURVEYS. Returns of surveys executed by the various surveying ships have been bound annually after the first volume which covered 1851–1861. The latter contained a manuscript summary of major surveys between 1832 and 1851. There followed ' A return to an order of the Honorable The House of Commons dated 25th November 1852 ' on the Hydrographical Survey (Scotland).

Printed ' Return of Survey ' forms were used from 1856 and tracings of areas surveyed later accompanied them. Included in the first volume is ' A Report on the present state of the coast survey in India, China, the Asiatic Archipelago and Australia ', which was issued from the Hydrographic Office on 1 March 1859 ' to enable officers who have leisure and opportunity to turn their time to the best account in aiding to correct the charts '.

3. 1879 *et seq.* ANNUAL REPORTS BY THE HYDROGRAPHER. The title-page in 1879 read:

> Return to an order of the Honourable The House of Commons dated 6th January 1881; Copy of a report by Captain F. J. O. Evans Hydrographer of the Navy, of the Work performed under the direction of the Lords Commissioners of the Admiralty during the Year 1879, in the Examination and Charting of the Seaboard in various Parts of the Globe.

In 1883 this became: 'Navy (Hydrographer's Report). Copy of a report on Admiralty Surveys for the year 1883. By the Hydrographer. Presented to both Houses of Parliament by Command of Her Majesty.' The last sentence disappeared after 1913.

Reports contain information on both departmental and surveying progress. Those for the years 1883–85 were printed by Eyre and Spottiswoode, but the following year it became an H.M.S.O. publication, with Darling and Sons as alternative printers. The original price was 1½*d*, becoming 2*d*, then varying between 1½*d* and 2½*d* until 1913 when it rose to 3½*d*. During the 1914–18 war the report was not put on sale; it reappeared, however, in 1920, priced 1*s* 3*d*. There is a bound volume in the Naval Library.

4. 1850 *et seq.* GENERAL INSTRUCTIONS FOR THE HYDROGRAPHIC SURVEYORS OF THE ADMIRALTY. According to a note in the edition of 1877, the instructions were originally drawn up by Beaufort and first appeared in that general form in 1850; revisions were effected in 1858 and 1862 and were again necessary in 1877. New editions have followed in 1884, 1888, 1902, 1915, 1933, 1938, 1945, 1953 and 1958. The last is a loose-leaf book to make amendment easier.

5. 1774 *et seq.* MANUALS OF HYDROGRAPHIC SURVEYING

1774. Murdoch Mackenzie, *Treatise on Maritime Surveying.*

1819. Supplement by Horsburgh.

1806. Dalrymple, *Essay on Nautical Surveying.*

1835. Belcher, *A Treatise on Nautical Surveying; containing an Outline of the Duties on the Naval Surveyor; with cases applied to Naval Evolutions and Miscellaneous Rules and Tables useful to the Seaman or Traveller.*

1872. Hull, *Practical Nautical Surveying.*

J. K. Laughton (Maths & Nav. Instructor, Greenwich), *Nautical Surveying.*

1874. Mayne, *Practical Notes on Marine Surveying and Nautical Astronomy.*

1882. Wharton, *Hydrographical Surveying.* Second edition 1898, assisted by Field and Moore. Third and fourth editions 1909 and 1920 revised and enlarged by Field.

1890. Shortland, *Nautical Surveying.* Published two years after his death.

1938. *Admiralty Manual of Hydrographic Surveying,* edited by Southern, second edition 1948.

3

Other Publications and Periodicals

1. The NAUTICAL MAGAZINE. First published in 1832, its prospectus read:

> The great object of the *Nautical Magazine* is the advancement of Hydrography by the diffusion of useful information, and on this ground the Proprietors respectfully solicit communications on the subject, however trifling, from the numerous intelligent seamen of the royal and mercantile Navy of Great Britain. The Proprietors feel assured that Mariners will derive incalculable benefit from the publication of the discovery of new dangers, as they are inserted in the Admiralty Charts, as also of similar information received at Lloyd's, all of which will be communicated to one of them, who is the agent for the sale of the above Charts; and they believe, that by these means the *Nautical Magazine* will not only be found useful to the seaman, but of great interest to all connected with him in this or in any other country. The *Nautical Magazine* will be published in Monthly Numbers, at the price of One Shilling. This arrangement will enable the Proprietors to give early publication to communications, addressed to Mr Bate, No. 21, Poultry, London.

Its publication and purpose was evidently welcome to the Hydrographic Department and it was subsidized in its early years by the Admiralty on Beaufort's suggestion recompensing Becher for his expenses in its publication. Besides a mass of navigational information there was for example in 1897 a sketch of Wharton, and contemporary descriptions of the Hydrographic Department, by Lord, and of the Nautical Almanac Office.

2. A MANUAL OF SCIENTIFIC ENQUIRY; prepared for the use of Her Majesty's Navy: and adapted for Travellers in General. Edited by Sir John F. W. Herschel, Bart. Published by authority of the Lords Commissioners of the Admiralty, 1849. Its introductory memorandum read:

> It is the opinion of the Lords Commissioners of the Admiralty that it would be to the honour and advantage of the Navy, and conduce to the general interests of Science, if new facilities and encouragement were given to the collection of information upon scientific subjects by the officers, and more particularly by the medical officers when upon foreign service . . . They are sending a surveying vessel to New Zealand, and have others in the Torres Straits and in other parts of the world. A new establishment is contemplated at Borneo. Expeditions are proposed in search of Sir John Franklin. They have cruisers in every sea; and where the ships of the navy are not present, it sometimes happens that the vessels of the merchant are conducted with much intelligence and enterprise, and for all these the work proposed would be valuable.

Astronomy, magnetism, hydrography, tides, geography, geology, earthquakes, mineralogy, meteorology, atmospheric waves, zoology, botany, ethnology, medicine and statistics were included. The frontispiece was a fine example of copperplate printing: ' The Approximate limits of the Great Currents and Drifts of the Ocean, compiled by Capt. F. Beechey.' Appendix 11 referred to ' Coasts and islands of which our hydrographic knowledge is imperfect', being 'An abstract from a Return made to the House of Commons 10th February 1848 from the Hydrographic Department of the Admiralty '.

It ran into five editions, with the section on hydrography revised by the Hydrographers up to Wharton in 1886.

3. List of British Discovery and Survey Vessels to 1900, Captain T. H. Tizard. A comprehensive list from the earliest days giving the period, captain's name, ship's name and area of survey.

4. Charting the Seas in Peace and War; the story of the Hydrographic Department of the Admiralty over a hundred and fifty years 1795 to 1945, H.M.S.O., 1947. It has a foreword by the Vice-Chief of Naval Staff and an introduction by the then Hydrographer, Rear-Admiral A. G. N. Wyatt.

5. Surveys of the Seas, Mary Blewett, MacGibbon and Kee, 1957. An introduction on hydrography and an outline of British surveying precede a selection of reproductions (14 by 9 inches) from original survey documents in the Hydrographic Department. Each carries a historical note and they date from 1670 to the end of the nineteenth century.

6. Sea Surveys, Edgell, The British Council, Longmans, Green & Co., 1948.

7. Marine Cartography in Britain, Robinson, Leicester University Press, 1962.

8. Indian Marine Surveys, Vols I to IV, 1860–1910. Hydrographic Department Library.

9. Final Report of the Departmental Committee on the Ordnance Survey, H.M.S.O., 1938.

10. The Atlantic Cable, Bern Dibner, Burndy Library, U.S.A., 1960.

11. The Royal Navy: A History from the Earliest times to the Present (in seven volumes), Clowes and others, Sampson, Low, 1897 to 1903.

12. British History in the Nineteenth Century and After, Trevelyan, Longmans, Green & Co., 1937.

13. The Admiralty, Sir Oswyn Murray, reprinted in *The Mariner's Mirror*, Vol. XXIII No. 1 to Vol. XXV No. 3 (1937–39).

14. England's Sea Officers, Michael Lewis, Unwin, 1939.

15. Periodicals: *Nature*, reports of the British Association for the Advancement of Science, journals of the Royal Geographical Society, *Journal of Institute of Navigation.*

16. The Bogus Surveyor, or, A Short History of a Peculiar People by Whitewash, the Surveyor's Friend, 1887. Probable author C. H. A. Gleig. Copies in the Naval Library and National Maritime Museum.

17. For the Record, L. A. Luff, 1962. Copy in the Hydrographic Department's historical records.

18. The Admiralty Chart, G. S. Ritchie, Hollis and Carter, 1967. This concurrently published story of British Naval hydrography in the nineteenth century is complementary to this book, particularly owing to its graphic descriptions of the principal people in surveying, the major tasks they undertook, and the conditions under which they worked during the last century.

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2. Officers in charge of surveys with their ships and surveys are also tabulated for each year, i.e. 1884–1903 pp. 166–205; 1904–9 pp. 236–47; 1910–14 pp. 280–9; 1915–19 pp. 329–33.

3. See also Appendix E for chronological lists of senior officers in the department.

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2. For the period reviewed in Chapter 1, surveys are discussed in general terms only (see p. 30, footnote[2]); Plate XI, however, illustrates those undertaken up to 1829.

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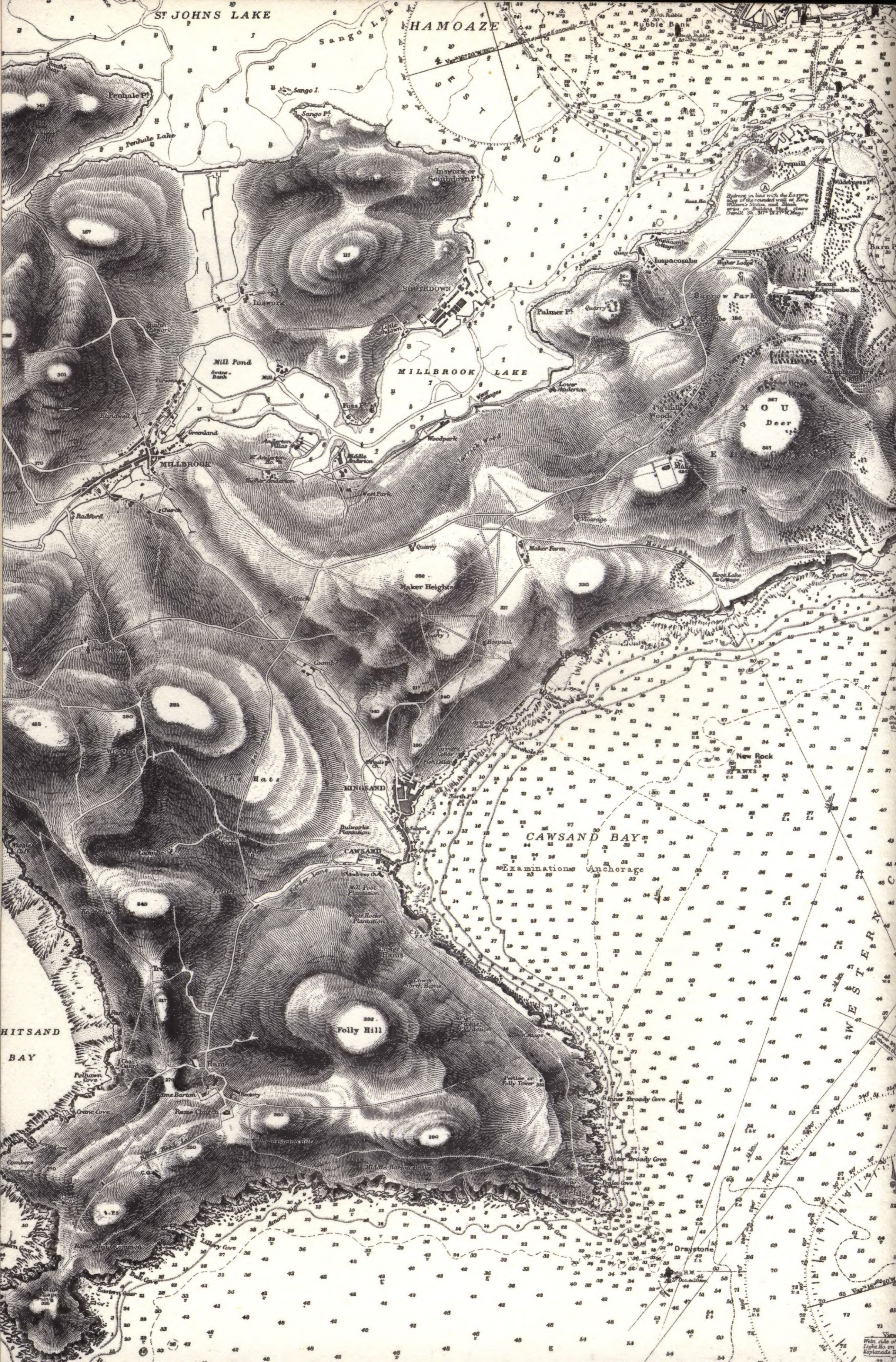
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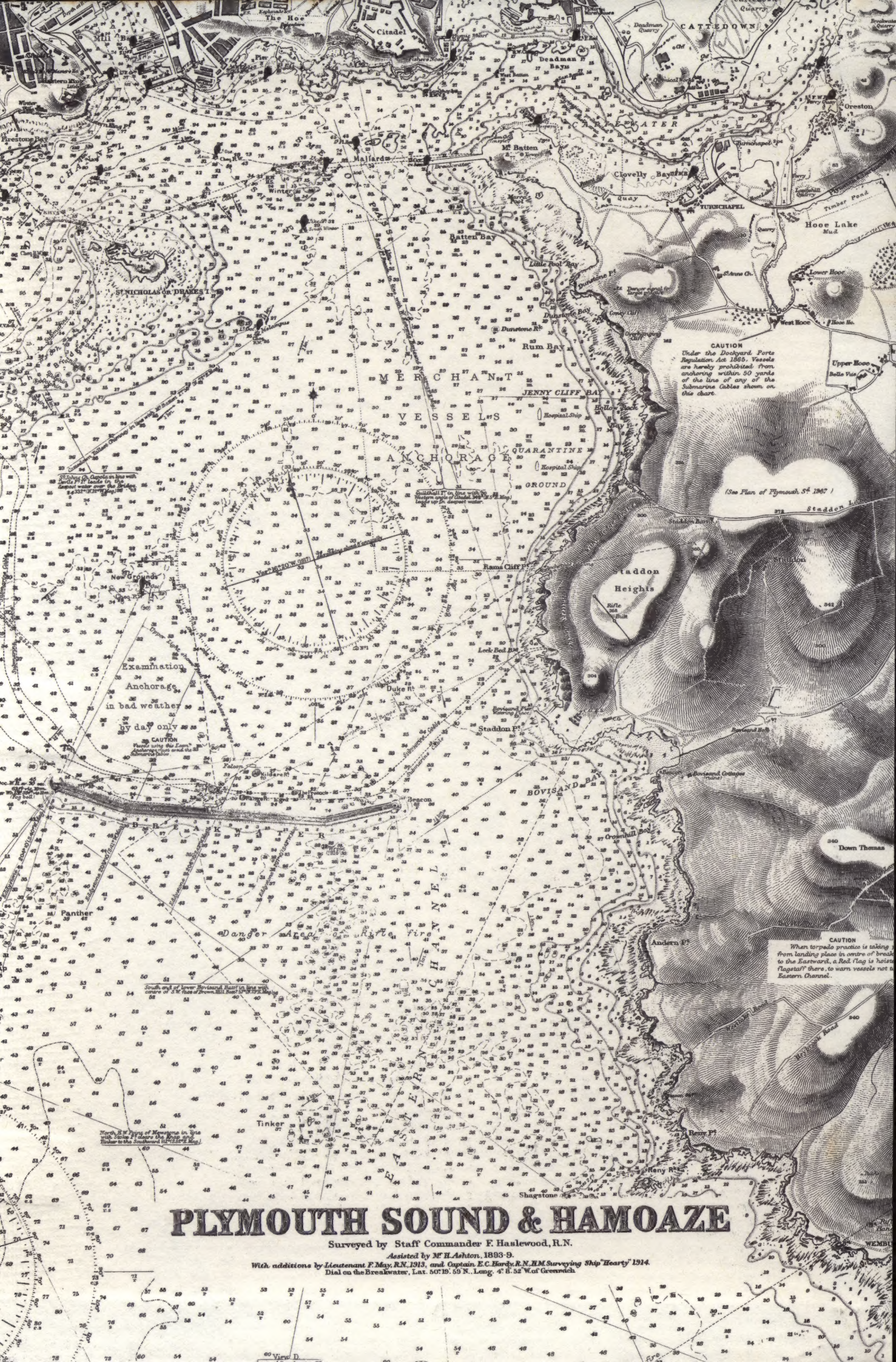

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